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San Juan Basin Action Plan

WATER QUALITY TECHNICAL REPORT

for the
Environmental Impact Statement
on Public Service Company of New Mexico's
Proposed New Mexico Generating Station
and Possible New Town

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Dear Interested Citizen:

Attached is one of twenty-two technical reports developed as a basis for writing the Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town (NMGS EIS). (A list of the technical reports is attached.)

These technical reports provide detailed information on the existing environment, methods used for the impact analysis, and related data supportive of the analysis and conclusions presented in the EIS. These reports should be retained for use with the Draft and Final EIS and other documents related to BLM's San Juan Basin Action Plan (SJBAP).

The Draft NMGS EIS will be filed with the Environmental Protection Agency and released for public review on November 30, 1982. Comments on the Draft EIS will be due by close of business February 7, 1983, at the BLM New Mexico State Office. Because of the large volume of material presented in the technical reports, the BLM is distributing these reports in advance of the Draft EIS to provide sufficient time for public review. The technical reports will be available for public review at the places indicated on the attached list. Copies will also be available from the BLM New Mexico State Office, U.S. Post Office and Federal Building, Santa Fe, for a copy fee.

Informational public meetings are scheduled for December 1982 to provide a public forum to clarify questions and concerns about the SJBAP proposals and the related environmental documents, which will all have been issued by that time. The meetings are scheduled as follows:

- December 14, Civic Center, Farmington, 3 to 9 PM
- December 14, Convention Center, Albuquerque, 3 to 9 PM
- December 15, Chapter House, Crownpoint, 3 to 9 PM
- December 16, Holiday Inn, Gallup, 3 to 9 PM
- December 16, Kachina Lodge, Taos, 3 to 9 PM

In addition, formal public hearings will be held in January 1983 to solicit public comments on the SJBAP Proposals. These meetings are scheduled as follows:

- January 10, Chapter House, Crownpoint, beginning at 1:00 PM
- January 12, Civic Center, Farmington, beginning at 9:00 AM
- January 14 (and 15th if necessary because of the number of registrants), Four Seasons Motor Lodge, Albuquerque, I-40 and Carlisle Blvd., beginning at 9:00 AM (each day)

Questions on the public meetings, hearings, and the technical reports themselves should be directed to:

Leslie M. Cone
NMGS Project Manager
BLM, New Mexico State Office
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

Sincerely yours,

Charles W. Luscher

Charles W. Luscher
State Director, New Mexico

List of Technical Reports

1. Purpose and Need
2. Project Description
3. Alternatives to the Project
4. Site Alternatives
5. Permit Reconnaissance
6. Air Quality
7. Geologic Setting
8. Mineral Resources
9. Paleontology
10. Soils, Prime and Unique Farmlands
11. Hydrology
12. Water Quality
13. Vegetation
14. Wildlife and Aquatic Biology
15. Threatened and Endangered Species
16. Cultural Resources
17. Visual Resources
18. Recreation Resources
19. Wilderness Values
20. Transportation
21. Social and Economic Conditions
22. Land Use Controls and Constraints

Availability of Technical Reports for Public Review

Individual copies of the technical reports can be obtained for a copy fee. Inquiries should be directed to:

Bureau of Land Management, New Mexico State Office
Title Records and Public Assistance Section (943B)
U.S. Post Office and Federal Building
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Santa Fe, NM 87501
(505) 988-6107 FTS 476-6107

Copies of the reports are available for public review at the locations listed below. [Formal and informal cooperating agencies are denoted by an asterisk (*).]

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P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

San Juan Energy Projects Staff (911)
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Public Affairs Staff (912)
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Farmington, NM 87401
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Socorro District Office
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Carlsbad, NM 88220
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State Historic Preservation Officer
505 Don Gasper Avenue
Santa Fe, NM 87503
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Santa Fe, NM 87503
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Santa Fe, NM 87503
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OTHER ORGANIZATIONS

Public Service Company of New Mexico
Alvarado Square
P.O. Box 2268
Albuquerque, NM 87158
(505) 848-2700

Woodward-Clyde Consultants, Inc.
3 Embarcadero Center, Suite 700
San Francisco, California 94111
(415) 956-7070

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Albuquerque, NM 87102

Aztec Public Library
201 W. Chaco
Aztec, NM 87401

Crownpoint Community Library
c/o Lioness Club, P.O. Box 731
Crownpoint, NM 87313

Cuba Public Library
Box 5, La Jara
Cuba, NM 87027

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Gallup Public Library
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Gallup, NM 87301

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Crownpoint, NM 87313
(505) 786-5228

Bureau of Indian Affairs*
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Salt Lake City, UT 84147
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Albuquerque, NM 87102
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Farmington, NM 87401
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National Park Service*
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1100 Old Santa Fe Trail
Santa Fe, NM 87501
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Environmental Coordination Office
Pinon Building, 1220 St. Francis Drive
P.O. Box 728
Santa Fe, NM 87501
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Field Supervisor, Ecological Services
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Albuquerque, NM 87107
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U.S. Geological Survey (WRD)*
505 Marquette Avenue, Room 720
Albuquerque, NM 87101
(505) 766-2810 FTS 474-2817

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Dallas, TX 75270
(214) 767-2716 FTS 729-2716

Navajo Tribe*
c/o Division of Resources
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Window Rock, AZ 86515
(602) 871-6592

Pueblo of Zia*
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(505) 867-3304

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Albuquerque, NM 87102
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Farmington, NM 87401

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WATER QUALITY TECHNICAL REPORT

for the

Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town

Prepared by

Woodward-Clyde Consultants

for the

U.S. Department of the Interior
Bureau of Land Management

CONTENTS

Section		Page
1.0	INTRODUCTION	1-1
	Background	1-1
	Summary Description of Project Components	1-2
	San Juan Basin Action Plan Overview and Relationship of the NMGS EIS to Actions Included in the Plan	1-11
	Baseline Conditions Assumed for the NMGS Technical Report Impact Analyses	1-12
	Organization of the Report	1-13
2.0	FRAMEWORK FOR ANALYSIS AND INDICATORS OF SIGNIFICANCE	2-1
	2.1 Areas of Influence	2-1
	2.2 Data Sources, Verifcation, and Gaps	2-2
	2.3 Indicators of Significance	2-3
	2.4 Interrelationships Between Different Baselines	2-3
	2.5 Report Organization	2-4
3.0	SAN JUAN RIVER DIVERSION	3-1
	3.1 Introduction	3-1
	3.2 Water Quality Standards and Criteria	3-1
	3.3 Existing Water Quality	3-8
	3.4 Future Water Quality	3-11
	3.5 Water Quality Impacts	3-14
4.0	GROUND-WATER WITHDRAWAL FROM WESTWATER CANYON MEMBER	4-1
	4.1 Baseline Water Quality	4-1
	4.2 Water Quality Impacts	4-12
5.0	POWER PLANT AND MINE SITE	5-1
	5.1 Surface-Water Quality	5-1
	5.2 Ground-Water Quality	5-6
	5.3 Surface-Water Quality Impacts	5-24
	5.4 Ground-Water Quality Impacts	5-36
6.0	WATER SUPPLY PIPELINE	6-1
	6.1 Baseline Water Quality	6-1
	6.2 Water Quality Impacts	6-2

Section		Page
7.0	TRANSMISSION LINES	7-1
7.1	Baseline Water Quality	7-1
7.2	Water Quality Impacts	7-1
8.0	SUGGESTED MITIGATION	8-1
9.0	UNAVOIDABLE ADVERSE IMPACTS	9-1
10.0	RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND LONG-TERM PRODUCTIVITY	10-1
POSSIBLE NEW TOWN		
1.0	AFFECTED ENVIRONMENT	1-1
2.0	ENVIRONMENTAL CONSEQUENCES	2-1
Appendix A	NEW MEXICO WATER QUALITY STANDARDS	
Appendix B	NEW MEXICO REGULATIONS FOR DISCHARGE ONTO OR BELOW THE SURFACE OF THE GROUND (WQCC 81-2, JULY 2, 1981)	
REFERENCES		
PREPARERS		

TABLES

Table		Page
3-1	Surface-Water Quality of the San Juan River and Its Major Tributaries	3-2
3-2	Beneficial Uses and Water Quality Criteria for the San Juan, Mancos, Chaco, La Plata, and Animas Rivers	3-4
3-3	Water Quality Criteria Recommended for Livestock and Irrigation Use	3-5
3-4	Water Quality Criteria Recommended for Steam Generation and Cooling in Heat Exchangers at the Point of Use	3-7
3-5	U.S. EPA Drinking-Water Quality Standards	3-9
3-6	Existing and Future TDS Concentrations in and Downstream of the San Juan River with and Without Salinity Improvement Projects	3-13
3-7	Estimated Increase in Levels of Suspended Solids Resulting from Dredging Activities in the San Juan River	3-17
3-8	Average Annual Salinity Changes at Three Downstream Locations in the Year 2010 with and Without Salinity Control Programs and at Two Levels of Withdrawal	3-22
3-9	Method Used to Calculate TDS Changes at Down-Stream Locations Resulting from San Juan River Diversion	3-23
4-1	A Summary of the Chemical Quality of Major Aquifers in the San Juan Basin	4-2
4-2	Chemical Analyses for Westwater Canyon Member Wells	4-7
4-3	Chemical Analyses for Entrada Sandstone Water from Apache Foshay Test Well	4-10
4-4	Chemical Analyses for Water from Dakota Sandstone Well	4-11

Table		Page
5-1	Surface Water Quality near the NMGS Plant Site	5-2
5-2	Trace Element Content of Stream Sediments	5-7
5-3	New Mexico Ground-Water Quality Standards	5-11
5-4	Water Quality in the PNM Alluvial Wells near the Plant Site	5-13
5-5	Well Samples with Water Quality in Excess of New Mexico Ground-Water Quality Standards	5-16
5-6	Water Quality of Other Selected Alluvial Wells Downstream of Plant and Mine Facilities	5-17
5-7	Water Quality in the Pictured Cliffs Sandstone	5-21
5-8	Average Water Quality of Wells in the Fruitland Formation near the Mine	5-23
5-9	Proposed New Source Performance Standards for the Steam Electric Power Generation Point Source Category	5-26
5-10	Definition of Process Blocks and Flow Nodes Shown on Figure 5-2	5-28
5-11	Typical Chemical Characteristics of Selected Waste Streams	5-32
5-12	Results of Laboratory Leaching Studies	5-33
5-13	Coal Storage Area Effluent Concentrations	5-39
5-14	Potential Failure Modes of Liners	5-42
5-15	Chemical Composition of Portland Cement, High Alumina Cement, Supersaturated Cement, and the Waste Mixture	5-50
7-1	Surface Water Quality Along the Transmission Line Routes	7-2

FIGURES AND MAPS

Figure		Page
1-1	Station Layout	1-4
3-1	Locations of Stations from Which Water Quality Data Have Been Collected	3-3
5-1	Locations of Stations near the Plant Site from Which Water Quality Data Have Been Collected	5-5
5-2	Process Flow Diagram for the Base Case Water Management System per Unit	5-27
Map		
1-1	General Location of Proposed Action	1-3
1-2	General Location of Alternatives, Including the Proposed Action	1-8
4-1	Generalized Map of the TDS Content of Water in the Westwater Canyon Member in the San Juan Basin	4-6
5-1	Locations of PNM and Other Wells at Which Water Quality Data Are Available	5-12

NEW MEXICO GENERATING STATION

1.0
INTRODUCTION

BACKGROUND

Included in the recent Council on Environmental Quality Regulations (1979) are several important objectives to reduce excessive paperwork in the preparation of environmental impact statements (EISs):

- Discuss only briefly issues other than significant ones.
- Emphasize the portions of the EIS that are useful to decision makers and the public and reduce emphasis on background material.
- Prepare analytic rather than encyclopedic EISs.

In order to accomplish these objectives and still provide the depth and background required for an analytic impact statement, this technical report has been prepared for the New Mexico Generating Station (NMGS) project. In this report, impacts that were not identified as significant but which are still considered important by the public or technical specialists are analyzed. Background material is provided for those issues and impacts that were considered necessary for the comparison of alternatives. Impacts that were not identified as significant or important by the public and by technical

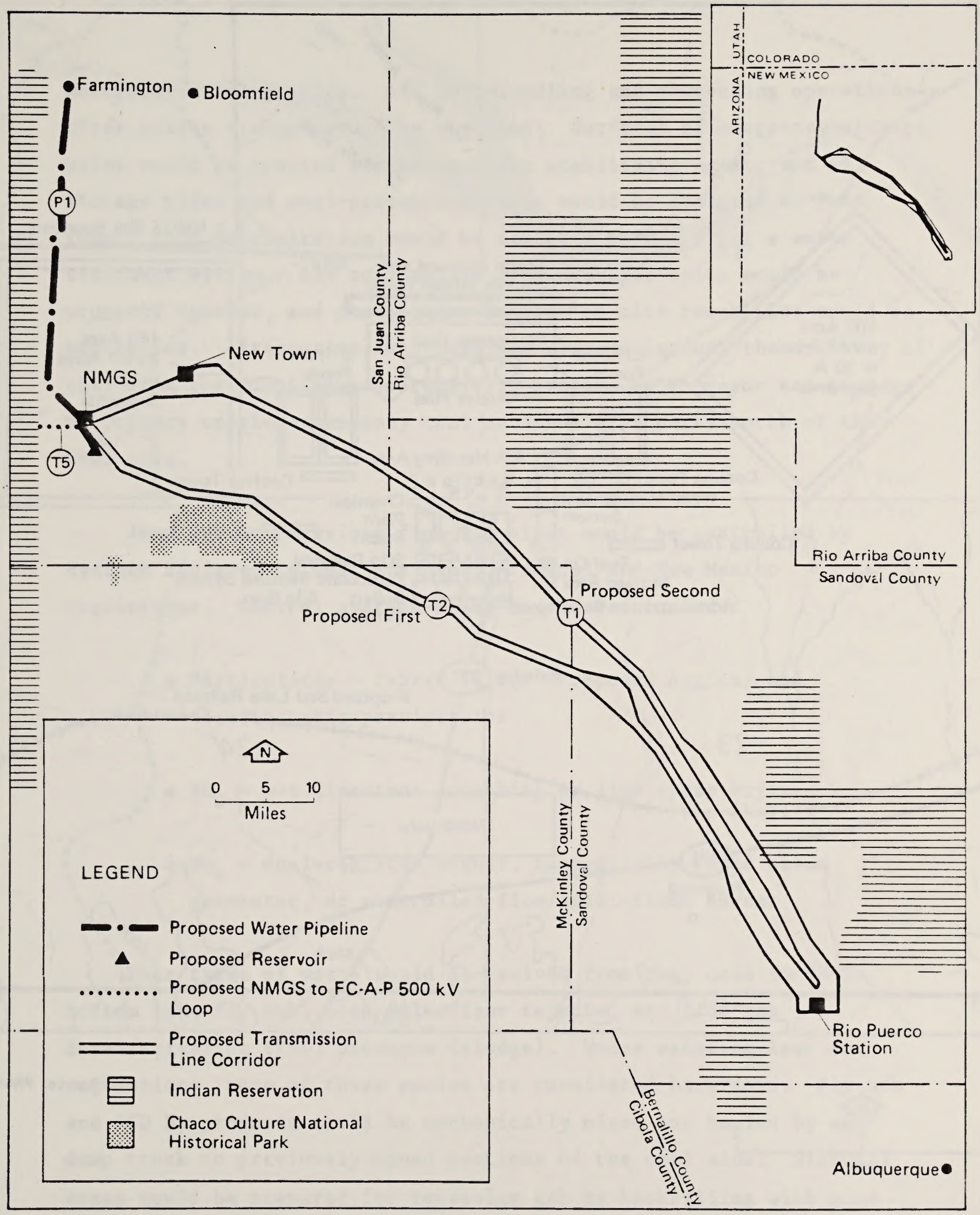
preparers are summarized, and reasons for their elimination from detailed analysis are discussed.

SUMMARY DESCRIPTION OF PROJECT COMPONENTS

Public Service Company of New Mexico (PNM) proposes to construct a 2000-megawatt (MW) coal-fired electric generation plant approximately 35 miles south of Farmington, New Mexico, in San Juan County (Map 1-1). The proposed NMGS, at ultimate development, would have four 500-MW generating units. Each generating unit would include a turbine generator area, coal pulverizer area, boiler area, particulate removal system, SO_2 removal system, and chimney stack. The proposed arrangement of these and other power plant components is shown in Figure 1-1. For the environmental analysis, it was assumed that commercial operation of the first 500-MW unit would begin in 1990 and that other units would start operating during the 1990s.

Coal for NMGS would be acquired through long-term contracts with Sunbelt Mining and Arch Minerals (Proposed Action) or other producers in the San Juan Basin (alternative coal supply). Coal acquired from a joint venture of Sunbelt and Arch Minerals would be supplied from surface mines (referred to as the Bisti mine in this analysis) in the immediate vicinity of the proposed plant site. Coal acquired from other producers in the San Juan Basin would be hauled from mines located as much as 30 miles from the proposed plant site. Coal required for NMGS would average 7.5 million tons per year, or a total of 300 million tons over the 40-year project life.

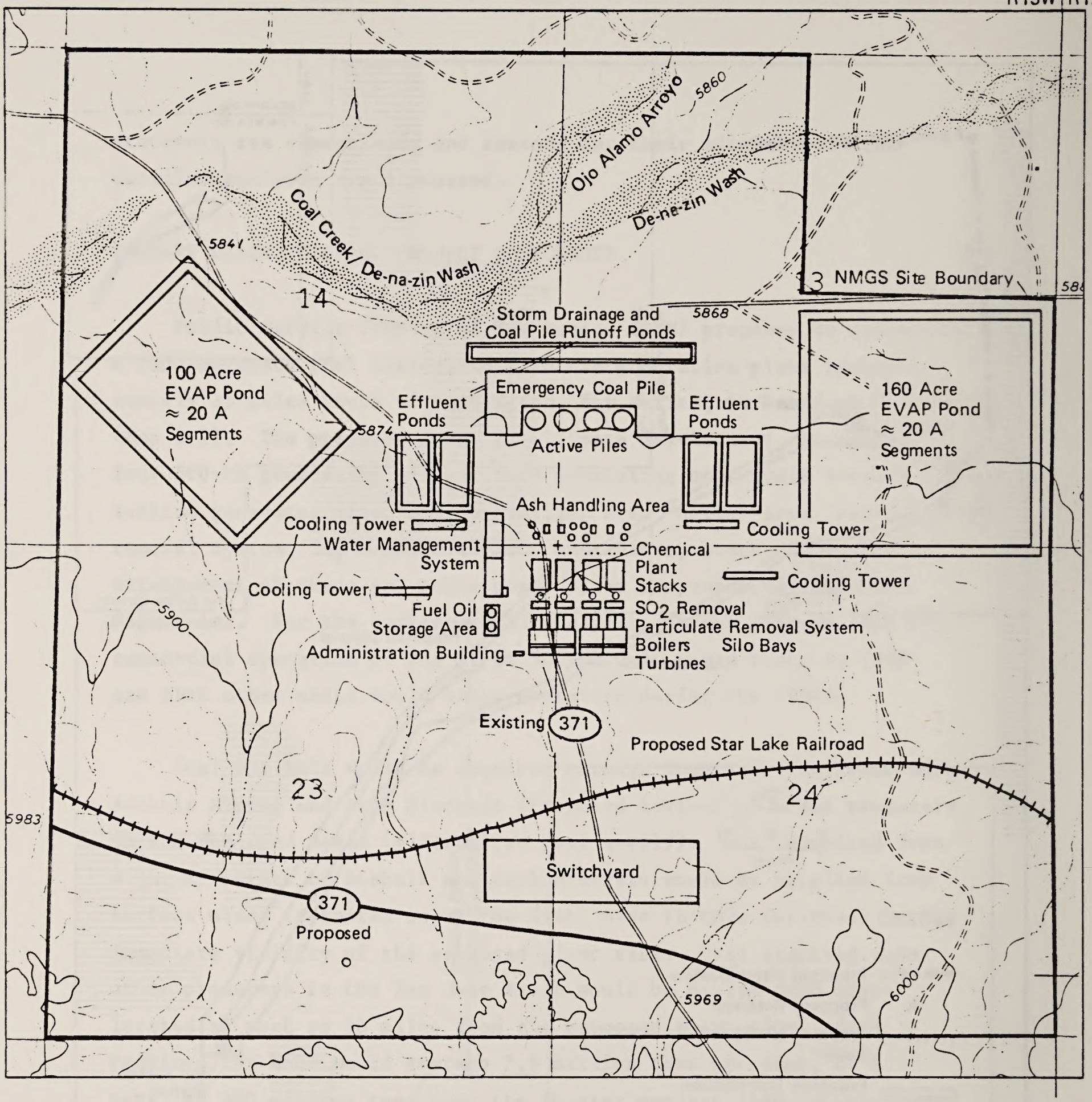
The proposed fuel-handling system would involve hauling coal from the Bisti mine (or other mine locations) by truck to a receiving facility located adjacent to the NMGS site. Coal would then be transferred via conveyor belt from the receiving station to active or



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-1. GENERAL LOCATION OF PROPOSED ACTION



Source: PNM 1982.

Figure 1-1. STATION LAYOUT

emergency storage piles. All coal-handling and processing operations after active storage would be enclosed. Surfaces of emergency storage piles would be treated with a nontoxic stabilizing agent, and all storage piles and coal-processing areas would be designed so that runoff from precipitation would be diverted to the plant's water treatment system. Any coal spills from conveyor belts would be promptly removed, and percolation beneath on-site stockpiles would be controlled. Alternative fuel-handling systems include the delivery of coal from the Bisti mine to receiving station by conveyor and storage of primary crushed emergency coal on Sunbelt property north of the NMGS site.

Atmospheric emissions from the plant would be controlled by systems designed to meet applicable federal and New Mexico regulations. Control systems being considered include:

- Particulates - fabric filter (Proposed Action) and electrostatic precipitator
- SO_2 - wet limestone scrubbing or lime spray drying
- NO_x - dual-register burner, tangentially fired steam generator, or controlled-flow/split-flame burner

Four types of waste would be derived from coal used in NMGS: bottom ash, fly ash, coal pulverizer rejects, and flue gas desulfurization (FGD) products (sludge). Under existing laws and regulations, none of these wastes are considered hazardous. Fly ash and FGD by-products would be mechanically mixed and hauled by end-dump truck to previously mined portions of the coal mine. Disposal areas would be prepared for receiving ash by backfilling with mine overburden. Ash would then be dumped and spread in layers over the

mine overburden. After the ash was placed and spread, it would be covered with layers of overburden and surface soil or topsoil and then a vegetative cover would be established. Bottom ash and pulverizer rejects would be collected for disposal in dewatering bins and then hauled by end-dump trucks for disposal into previously mined portions of the coal mine. Procedures for disposal would be the same as for fly ash.

The water management system would contain all equipment necessary to treat and supply all the plant makeup water and potable water. The power plant would be designed and operated as a zero-discharge plant; wastewater would be reused by cascading it to uses requiring successively lower water quality. Used water, degraded to the extent that it could not be economically treated for further in-plant use, would be used for transport and disposal of plant-generated wastes or would be discharged to evaporation ponds (Figure 1-1). Evaporation ponds would be lined with impervious material to limit seepage losses.

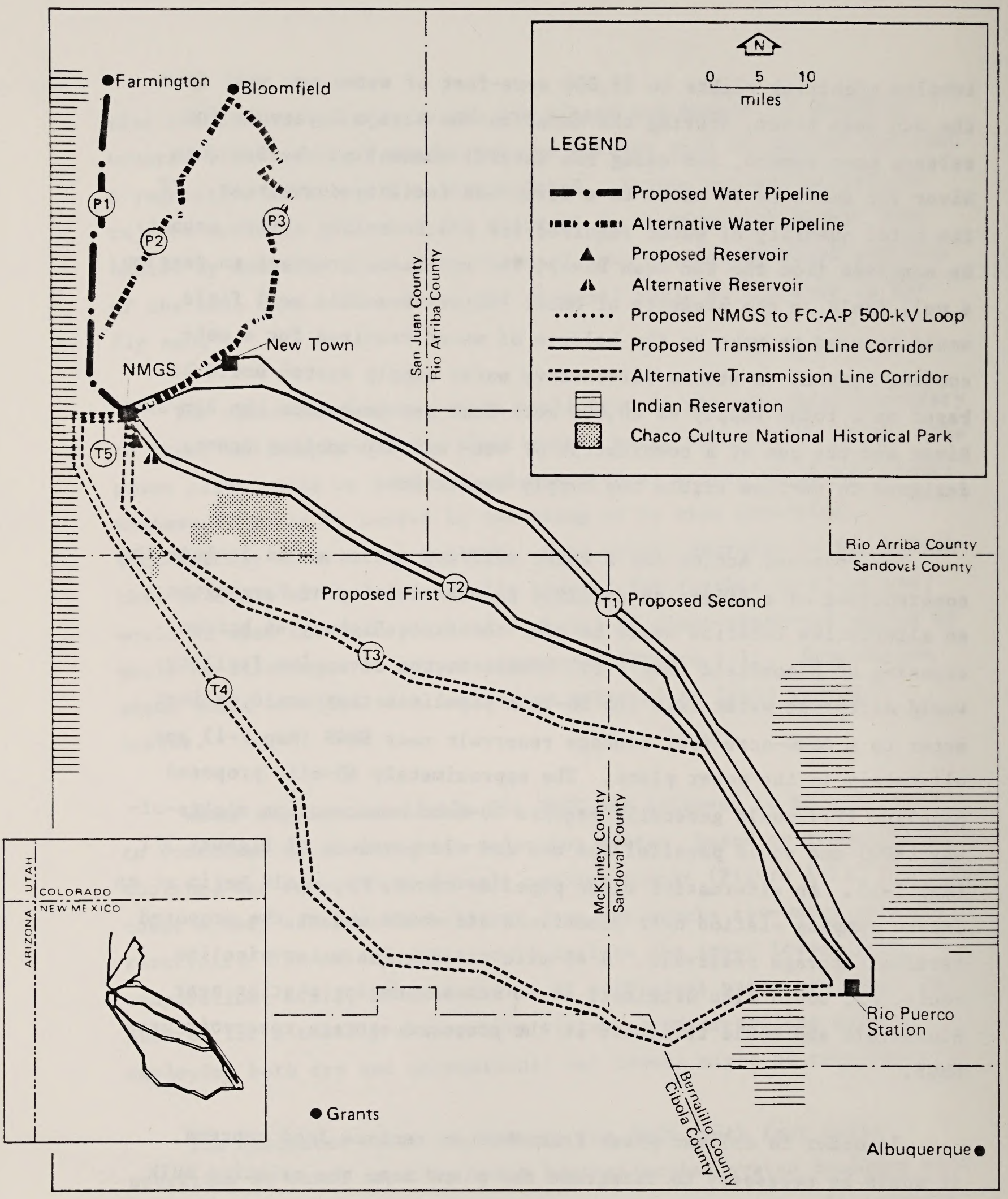
Water supplies available for NMGS are believed to be sufficient to construct an all-wet heat-rejection system, based on evaporative cooling, and to use forced-draft cooling towers (Figure 1-1). Cooling-tower makeup water would be drawn from the nearby raw-water storage reservoir. The makeup water would replace the tower losses from evaporation, drift, and blowdown. If sufficient water could not be secured for a totally evaporative system, a water-cooling system employing both dry and conventional wet towers might be required.

The estimated water requirement for NMGS, with four units operating at rated capacity and a heat-rejection system equipped with wet-cooling towers, would be 35,000 acre-feet per year. In order to supply this quantity of water to NMGS, the Proposed Action would

involve acquiring rights to 35,000 acre-feet of water per year from the San Juan River, storing the water in the Navajo Reservoir for release upon demand, and using the natural channel of the San Juan River for delivery of water to a diversion facility downstream. If the total quantity of water required for a wet-cooling system cannot be acquired from the San Juan River, the applicant proposes to develop a well field in the vicinity of NMGS. Water from this well field would be used to make up the balance of water required for a wet-cooling system. A second alternative water supply system would be based on a total supply of 20,000 acre-feet per year from the San Juan River and the use of a combination of wet- and dry-cooling towers designed to perform within the supply constraint.

The Proposed Action for a water delivery system would include the construction of a diversion facility in the vicinity of Farmington; an alternative location would be near the State Highway 44 bridge crossing at Bloomfield (Map 1-2). Pumps at the diversion facility would discharge water into two 36-inch pipelines that would deliver water to a 4000-acre-foot storage reservoir near NMGS (Map 1-1) and ultimately to the power plant. The approximately 40-mile proposed pipeline (P1) would generally require 90-foot construction rights-of-way (ROW) and would parallel the new and old portions of Highway 371 (Map 1-1). An alternative water pipeline route, P2, would begin at an intake pumping station near Bloomfield and would end at the proposed terminal storage reservoir. A 49-mile alternative water pipeline route, P3, would also originate at an intake pumping station near Bloomfield and would terminate at the proposed storage reservoir near NMGS.

In order to deliver power from NMGS to various load centers, it would be necessary to integrate the plant into the existing bulk



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-2. GENERAL LOCATION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

transmission systems of PNM and neighboring utilities. Thus the proposed transmission system would consist of a 500-kilovolt (kV) loop linking NMGS with PNM's approved 500-kV Four Corners-Ambrosia-Pajarito (FC-A-P) line, located approximately 5 miles west of NMGS, and two 500-kV lines linking NMGS with the Albuquerque distribution and load center at the proposed Rio Puerco Station (Map 1-1). The NMGS-Albuquerque system would be installed in phases: the 500-kV loop in 1990 with commencement of commercial operation of Unit 1, the first 500-kV line with Unit 2 in 1993, and the second 500-kV line with Unit 4 in 1998.

Four routes are considered technically and economically feasible for construction of the 500-kV transmission system. Route T2 is proposed for the first 500-kV line and route T1 is proposed for the second 500-kV line; routes T3 and T4 are alternatives to the Proposed Action. The total distance traversed would be similar for the two proposed and two alternative corridors: 101 miles (T2), 107 miles (T1), 105 miles (T3), and 126 miles (T4). With the exception of tower sites, the proposed 200-foot ROW could support other compatible land uses, such as grazing. PNM would keep the transmission line ROW closed and would patrol the line by helicopter each month. Lands disturbed by heavy equipment and temporary access roads would be restored to their original condition.

Table 1-1 displays construction work force estimates over time. Construction employment for station facilities would reach peaks of 1515 employees in 1987 and 1530 employees in 1992. Operations employment at station facilities would increase steadily, from 30 employees in 1989 to 900 employees in 1999 when all four units are expected to be on-line.

Table 1-1. NMGS CONSTRUCTION AND OPERATION EMPLOYMENT

Year	Intake Pipeline and Reservoir	500-kV Transmission Line	NMGS Construction Unit 1	Unit 2	Unit 3	Unit 4	Total	NMGS Operation Unit 1	Unit 2	Unit 3	Unit 4	Total	Total Employment	Annual Change
1985	—	—	85	—	—	—	85	—	—	—	—	—	85	+85
1986	—	—	800	—	—	—	800	—	—	—	—	—	800	+715
1987	115	—	1515	—	—	—	1630	—	—	—	—	—	1630	+830
1988	295	104	1180	30	—	—	1505	—	—	—	—	—	1505	-125
1989	—	—	360	450	—	—	914	30	—	—	—	30	944	-560
1990	—	—	100	940	40	—	1080	200	—	—	—	200	1280	+336
1991	—	—	—	750	570	—	1320	250	—	—	—	250	1570	+290
1992	—	—	—	270	1260	—	1530	250	24	—	—	274	1804	+234
1993	—	—	—	105	955	30	1090	250	160	—	—	410	1500	-304
1994	—	78	—	—	325	435	838	250	200	30	—	480	1318	-182
1995	—	—	—	—	90	940	1030	250	200	200	—	650	1680	+362
1996	—	—	—	—	—	775	775	250	200	250	—	700	1475	-205
1997	—	—	—	—	—	255	255	250	200	250	24	724	979	-496
1998	—	—	—	—	—	95	95	250	200	250	160	860	955	-24
1999	—	—	—	—	—	—	0	250	200	250	200	900	900	-55

Source: PNM 1980, unpublished data.

According to PNM (unpublished data, 1980), estimated construction employment skill requirements would be as follows:

Skill	Percent of Total Construction Work Force
Boilermakers	9.4
Pipefitters	14.2
Electricians	14.4
Carpenters	5.6
Ironworkers	10.0
Operators	10.0
Laborers	9.0
Teamsters	4.1
Cement masons	0.8
Millwrights	3.3
Insulators	4.0
Sheetmetal workers	1.1
Painters	1.2
Others	0.5
Supervision	12.4

The above estimates are averaged for construction of all four units.

SAN JUAN BASIN ACTION PLAN OVERVIEW AND RELATIONSHIP OF THE NMGS EIS TO ACTIONS INCLUDED IN THE PLAN

The proposed site for the NMGS is located in the San Juan Basin of northwestern New Mexico. The Bureau of Land Management (BLM) is responsible for the management of much of the land and mineral resources in this area, and currently has six separate but

interrelated proposals under consideration within the basin. In order to respond to these, the BLM has developed a San Juan Basin Action Plan (SJBAP). This plan provides for the organizational arrangements whereby the environmental analyses and decision making can be implemented in a timely and efficient manner. The plan describes the process for preparation of three site-specific EISs (including the NMGS EIS) and three Environmental Assessments (EAs):

- Coal Preference Right Lease Applications (EA)
- San Juan River Regional Coal Leasing (EIS)
- Wilderness Study Areas (WSAs) (EIS)
- New Mexico Generating Station (EIS)
- Ute Mountain Land Exchange (EA)
- Bisti Coal Lease Exchange (EA)

In addition to these documents, the action plan provides for the preparation of a Cumulative Overview (CO). The CO is intended to focus on the cumulative impacts that would result from the proposed actions analyzed in the EISs and EAs listed above and therefore to facilitate public review and decision making. As a result of this organization, the impact analysis in the NMGS EIS and technical background reports concentrates on the impacts expected to result from the specific NMGS components proposed. The cumulative impacts expected to result from the proposed NMGS, in addition to the cumulative impacts of other proposals to be developed in the same time period, are described in the CO.

BASELINE CONDITIONS ASSUMED FOR THE NMGS TECHNICAL REPORT IMPACT ANALYSES

The site-specific impact analysis for this technical report was based on the affected environment and available resources that would

be existing at the time of construction and operation of the NMGS facility. Since construction at the NMGS facility would not begin until 1985, certain assumptions regarding project development in the San Juan Basin were necessary. Two levels of project development were considered, along with criteria for each, in developing a status for the various non-SJBAP actions proposed for the San Juan Basin area.

- Baseline 1 - The projects considered in this level of development are those that have approval and are to be built or under construction in 1985. This level represents the projected existing environment without the proposals included in the SJBAP.

- Baseline 2 - The projects considered in this level are in some phase of the application stage. In this level, Baseline 1 projects are added to any projects in Baseline 2 along with any revision in resource production or uses (e.g., coal).

Where differences in Baselines 1 and 2 affect the results of impact analyses, discussion is provided. If no differences are identified, it should be assumed that consideration of the two different baselines did not alter the impact analyses.

A complete list of projects and comprehensive location maps for Baselines 1 and 2 are provided in Appendix C of the NMGS EIS.

ORGANIZATION OF THE REPORT

Section 2.0 of this technical report describes the assumptions and methodological approach used in the assessment of potential impacts of the Proposed Action on the affected environment. In

addition, Section 2.0 contains a definition of the study area and identification of data sources.

Section 3.0, Affected Environment, contains baseline data on existing conditions in the study area, as well as projections of future conditions without the Proposed Action. Information on historical trends is presented where it is useful in providing a basis for predicting most likely future trends. The description of projected future trends takes into consideration the changes in the environment that are expected to occur as a result of the projects identified in Baseline 1. This provides a reasonable estimate of the future existing environment against which the potential impacts of the Proposed Action and alternatives can be assessed.

Section 4.0 describes the potential effects of implementing the Proposed Action and alternatives. Impacts identified are measured against indicators of significance in order to estimate the importance of the impact to the affected human environment. (Potential impacts associated with alternatives to the Proposed Action are compared in Section 9.0.)

In Section 5.0, mitigation measures are suggested. These measures would help to alleviate the potentially significant adverse impacts or enhance the beneficial impacts identified in the Section 4.0 analysis. Those potentially adverse impacts for which no appropriate mitigation measures have been suggested are discussed in Section 6.0 as "unavoidable adverse impacts."

2.0 FRAMEWORK FOR ANALYSIS AND INDICATORS OF SIGNIFICANCE

The purpose of this report is to assess the effects of construction and operation of the Proposed Action on the quality of affected surface- and groundwater resources. In order to assess water quality effects, a framework of analysis was developed. Several factors were important in shaping this framework. The description of the project (including the design, construction, and operation aspects of various components) was the most important factor driving the analysis. This factor was used to define geographic area of influence, as well as the generic effects of individual project components. Scoping analysis reinforced the above approach by re-emphasizing important issues. Relevant water quality data were then collected in the defined areas of influence.

Based on the project description and information about the generic effects of different project components, potential effects were identified. The magnitudes of these potential effects were then compared with chosen indicators of significance to determine whether an effect was, in fact, significant. The following discussion includes: (1) the areas of influence for project components; (2) the sources for, verification of, and gaps remaining in data collected for this project; and (3) indicators of significance used to define the occurrence of significant impacts. In addition, the effects of different baselines on potential effects are discussed, as well as the organization of the report.

2.1 AREAS OF INFLUENCE

Construction of all the project components could potentially affect stream suspended solids content in the immediate vicinity of these facilities. Other potential effects--such as spills of solvents, cleaning solutions, and fuels, and disposal of sewage and solid wastes--would also be limited to the immediate vicinity of the proposed facilities. The potential operational effects of the water supply pipelines and the electric transmission lines would also be limited to the immediate vicinity of these facilities. Withdrawal of up to 35,000 acre-

feet of water from the San Juan River could potentially affect the entire Colorado River System. Potential operational effects of the power plant during normal operating conditions would be limited to the immediate vicinity, as the zero-discharge water and wastewater management system would eliminate surface-water discharge. However, downstream surface and ground waters could potentially be affected during upset, off-design, or high rainfall conditions. Potential migration of wastewaters or waste leachates would be limited to the immediate vicinity of plant or mine sites (if solid wastes are returned to the mine as presently proposed). It is also possible that power plant atmospheric emissions could contribute toward the tendency of certain high mountain lakes in southern Colorado to become acidic when subjected to acidic precipitation (see Air Quality Technical Report).

2.2 DATA SOURCES, VERIFICATION, AND GAPS

Baseline data on existing water quality in the affected areas were collected from appropriate sources, such as the reports and records of the U.S. Geological Survey (USGS), the Environmental Improvement Division of the New Mexico Health and Environment Department, the U.S. Bureau of Reclamation, Public Service Company of New Mexico (PNM, the applicant), Bureau of Land Management (BLM), and various other sources. Primary sources of data documenting the effects of coal-fired power plants on water quality were the U.S. Environmental Protection Agency (EPA) and the Electric Power Research Institute (EPRI). The U.S. Bureau of Reclamation was a source of data about the effects of water supply systems. The open scientific literature was also examined to collect additional data as necessary.

Basic procedures that were used to examine the accuracy of water quality data included examination of the cation-anion charge balance as well as the percentage error in measured versus calculated values of the total dissolved solids. These procedures provide checks on the overall quality of the data. Water quality data published by the USGS have already been checked with these procedures. Trace element information was compared against itself (i.e., if more than one measurement at a given site was made), against available

upstream or downstream data on the same stream, and against water quality standards and criteria. Identification and resolution of data gaps were begun early in the data collection phase and continued throughout impact analysis. Additional water quality sampling, a procedure that was to be used to fill data gaps, was not necessary because existing data about the ambient environment were judged to be sufficient.

2.3 INDICATORS OF SIGNIFICANCE

The significance of the water quality effects of the various project components was evaluated in terms of the water quality criteria or standards applicable to the water body in question. A water quality effect was judged to be significant when the standards or criteria that have been designated to protect the beneficial uses of the water body in question were exceeded. Specific standards include the surface- and ground-water quality standards of the New Mexico Water Quality Commission. Specific water quality criteria include those criteria listed in EPA's "Blue" book (NAS 1973) and "Red" book (EPA 1976), and the recently promulgated water quality criteria for toxic pollutants.

2.4 INTERRELATIONSHIPS BETWEEN DIFFERENT BASELINES

As discussed above, two baselines have been developed for specific consideration in this report. From the standpoint of potential water quality impacts caused by this project, there would be little or no difference between the baselines. Little difference exists because most water quality effects would be limited to the immediate vicinities of the proposed facilities. No substantial differences (related to potential changes in San Juan River water quality in the affected reach) between different baselines were predicted.

3.0 SAN JUAN RIVER DIVERSION

3.1 INTRODUCTION

The quality of water in the San Juan River may be affected during either construction or operation of the proposed project. The present water quality of the San Juan River and its major tributaries in the area of project facilities is shown in Table 3-1. The selected tributaries include the Animas River at Farmington, the La Plata River near Farmington, the Chaco River near Waterflow, and Gallegos Canyon near Farmington. Water quality data for San Juan River stations near Bloomfield, above the Animas River, and at Shiprock are also tabulated. The locations of these San Juan River stations as well as those of the selected tributary stations are shown in Figure 3-1. All of the tributary inputs result from perennial flows except that from the intermittent Gallegos Canyon near Farmington. Although most of the Chaco River is intermittent, the Chaco River near Waterflow is perennial because of discharges from the Four Corners Power Plant.

3.2 WATER QUALITY STANDARDS AND CRITERIA

The values of the water quality parameters for the monitoring stations listed in Table 3-1 can be compared with New Mexico state water quality standards and other water quality criteria appropriate for the designated beneficial use of the receiving body in question. The water quality standards of the state of New Mexico include an antidegradation policy, general standards for all surface waters that are suitable for recreation and support of desirable aquatic life common in New Mexico waters, and other standards specific to the water body in question. The antidegradation policy and the general standards are presented in Appendix A. The designated beneficial uses of the San Juan River in the area of interest and the water quality standards required to protect these uses are tabulated in Table 3-2. Water quality criteria applicable to irrigation and livestock watering are listed in Table 3-3. Water quality criteria applicable to water use in steam generation facilities are listed in Table 3-4.

Table 3-1. SURFACE WATER QUALITY OF THE SAN JUAN RIVER AND ITS MAJOR TRIBUTARIES[a]

Water Quality Parameters[b]	San Juan River near Bloomfield Lat 36°41'22" Long 108°5'42"	Gallegos Canyon near Farmington, NM	San Juan River above Animas River Lat 36°43'10" Long 108°12'45"	Animas River at Farmington Lat 36°43'12" Long 108°12'8"	La Plata River near Farmington Lat 36°44'23" Long 108°14'51"	Chaco River near Waterflow Lat 36°43'28" Long 108°35'27"	San Juan River at Shiprock Lat 36°47'32" Long 108°43'54"
General Constituents							
Flow, cfs	1526(294-5460) 64	11(0-98) 19	———	1270(11.1-8240) 202	84(0-2660) 99	188(.56-1970) 313	2108(215-11300) 294
Dates	12/9/77 - 4/2/81	2/3/78 - 4/3/81	9/18/58 - 9/25/79	10/10/54 - 5/6/81	2/29/44 - 5/29/81	10/8/69 - 6/11/81	70 - 77
Water Temperature, °C	11.5(1-25) 64	9(0-26) 17	12(0-28) 190	———	14(0-34) 119	14.4(0-35) 125	11.9(0-30) 152
pH, S.U.	8.3(7.9-8.9) 44	8.6(8.2-9.1) 13	7.9(6.8-9) 174	7.8(7-9.1) 604	8.2(7.1-8.6) 52	7.7(6.8-8.9) 147	8(7-9) 347
Specific Conductance, µmhos/cm	416(250-695) 44	1740(390-2850) 13	499(226-1800) 214	603(101-1340) 638	2430(517-5020) 112	1970(310-10900) 149	700(280-6379) 370
Total Dissolved Solids	266(168-478) 38	1170(488-1810) 10	306(156-1270) 134	403(114-856) 181	1720(350-3680) 32	1595(517-3470) 46	449(170-2020) 369
Suspended Solids	1210(99-23500) 61	30200(46-117000) 16	———	2790(8-27900) 263	3980(21-35010) 50	39780(2.6-280,000) 242	———
Turbidity, FTU	———	———	———	130(1.5-1300) 25	380(1-8500) 31	3580(6.1-15000) 9	
Alkalinity, as $CaCO_3$	97(66-213) 41	280(104-591) 11	101(69-226) 48	134(50-1560) 306	207(97-450) 65	137(26-468) 63	118(21-250) 369
Hardness, $CaCO_3$	133(91-200) 40	126(19-270) 13	158(76-350) 175	243(80-608) 567	880(150-1600) 67	708(74-1900) 49	229(110-800) 369
Dissolved Oxygen	10(7.4-12.6) 41	10(5.5-14) 12	10(5.5-13.7) 56	9.7(6-14.2) 109	9.1(5.6-13) 38	9.6(6.3-14.2) 41	9.8(6-14.5) 85
Total N, as N	1.1(.19-9.4) 32	9.5(1.2-47)12	———	1.2(0.05-16) 93	3.2(.11-22) 31	5.6(1.8-14) 20	1.8
Total P, as P	.23(0.01-3.8) 36	1.1(0.03-3.8) 13	———	.18(0-2.8) 105	.56(0-5.4) 33	.71(.01-4.8) 24	.7(.04-6.4) 47
Dissolved Organic Carbon	5.6(3-19) 36	9.4(2.1-23) 13	———	3.5(.9-12) 54	7.7(3.5-15) 33	5.2(3.2-13) 27	———
Common Ions							
Calcium	42(28-65) 40	43(6.9-90) 13	49(29-120) 135	79(24-211) 570	220(46-410) 63	193(26-500) 48	72(24-240) 309
Magnesium	7.1(4.4-10)40	4(.4-10) 13	7.6(2.4-15) 135	11(1.7-55) 562	83(8.6-270) 62	55(2.3-210) 49	13(5-49) 369
Sodium	33(14-73) 40	340(89-540) 13	41(14-270) 135	33(.29-98) 538	260(23-700) 40	247(130-710) 47	57(4-310) 327
Potassium	2.2(1.6-2.9) 40	3.5(1.9-5.4) 13	2.3(1.7-6.3) 114	3.1(.9-6.9) 180	4.3(.8-9) 39	7.8(4.3-16) 46	1.8(1.5-9) 327
Bicarbonate	114(80-260) 41	316(110-650) 11	122(70-275) 160	155(60-1900) 549	250(118-550) 65	173(9-570) 52	144(25-310) 369
Sulfate	110(50-250) 39	608(65-1300) 13	134(48-700) 133	166(35-500) 214	1120(160-2500) 71	945(240-2800) 48	210(56-2100) 369
Chloride	3.8(2.2-6.6) 40	28(6.1-49) 13	4.9(1.3-18) 178	19(1.8-52) 219	108(7.7-420) 67	113(14-300) 48	14(3-86) 369
Silica	10.6(7.5-26) 39	11.2(5.6-18) 12	11(7.4-18) 133	8(2.4-17) 213	9.4(3.7-17) 39	7.4(0.4-22) 48	9.2(0-37) 368
Fluoride	.23(.2-.3) 40	1(0.4-1.6) 13	.3(0-1.4) 111	.5(.1-6) 212	.5(.2-.9) 39	3.6(0.1-13) 48	———
Boron, dissolved	.041(0.0-.14) 40	.15 (.05-.23) 12	.042(0-.16) 88	.09(0-1) 171	.1(0-.2) 41	4.56(.26-25) 70	———
Iron[c]	1.6(.54-3.3) 7/.03(0-.28) 40	2.63(.46-4.8) 2/.17(.01-.78) 13	———	8.3(.02-100) 20/.03(0-.6) 136	.55(.15-1.3) 6/.04(0-.34) 38	114.4(.23-790) 69/.03(0-.34) 68	37.9(.76-350)/.012(0-0.06)
Manganese[c]	.1(.04-.3) 14/.02(.004-.05) 19	.1(.04-.17) 2/.01(0-.02) 3	———	.42(.03-3.3) 20/.07(0-.62) 32	.93(.08-4) 13/.24(0-.96) 17	4.6(.04-30) 69/.012(0-.9) 46	1.3(.08-12)/.012(0-.06)
Trace Elements, µg/l[c]							
Arsenic	3.6(1-20) 8/1.2(1-2) 13	3(2-4) 2/3(2-5) 3	2(2) 2	3.9(0-45) 21/.9(0-3) 29	5.5(0-24) 8/1(0-2) 12	54(0-350) 97/3.7(0-20) 36	12(1-56) 20/1.4(0-8) 20
Cadmium	.75(0-1) 8/1(1) 13	0(0) 2/1(0-2) 3	———	3.8(0-10) 20/3.6(0-10) 29	.5(0-2) 8/.8(0-1) 12	6(0-30) 22/.6(0-3) 17	6.2(1-10) 20/.3(0-1) 20
Chromium	2.5(1-10) 8/.8(0-10) 13	15(10-20) 2/10(0-20) 3	———	12(0-92) 20/11(0-82) 18	30(0-120) 8/3(0-10) 11	163(0-440) 42/3.5(0-10) 18	17(0-180) 20/1.3(0-20) 20
Copper	20(7-48) 8/5.3(1-10) 13	6(4-8) 2/8(1-20) 3	———	33(3-160) 24/3(0-10) 28	64(5-280) 8/5.5(0-16) 12	217(7-2300) 20/3.1(0-10) 17	69(7-580) 20/3(1-6) 20
Lead	.2(2-38) 8/4(0-18) 13	6(1-11) 2/3(0-8) 3	100(100) 2	99(1-700) 33/5(0-39) 21	20(3-96) 7/5(0-25) 11	277(0-1400) 67/1.4(0-9) 32	96(10-200) 15/1.0(0-5) 16
Mercury	.23(0-1.1) 8/.05(0-.3) 13	0(0) 2/.27(0-.5) 3		.23(0-4) 30/.03(0-.3) 19		1(0-3.8) 51/.06(0-.5) 19	.11(0-.5) 20/.07(0-.2) 20
Nickel	6(2-16) 8/.5(0-3) 13	2(1-3) 2/5(2-7) 3		3.7(0-7) 7/3(0-10) 7	30(3-140) 8/2(0-5) 12	7(7) 1/0(0) 1	———
Selenium	.9(0-1) 8/.7(0-1) 13	3.5(3-4) 2/3.3(0-7) 3	1(1) 2/46(0-180)4	1.5(0-7) 21/19(0-540) 33	1.3(0-5) 8/1.3(0-6) 12	10(0-51) 64/12(1-47) 19	3.2(0-10) 20/2.4(0-8) 20
Zinc	40(20-80) 8/46(5-440) 13	25(20-30) 2/30(20-50) 3		204(10-870) 24/29(0-340) 28	184(0-940) 8/18(0-50) 4	258(30-1100) 18/13(3-40) 17	250(10-1300) 20/12(0-90) 20

Source: U.S. EPA STORET Print-out, 9/81.

[a] The first value reported is mean value; the numbers in parentheses are the range of values; the third value is the number of measurements.

[b] All units mg/l unless otherwise indicated.

[c] Total/Dissolved

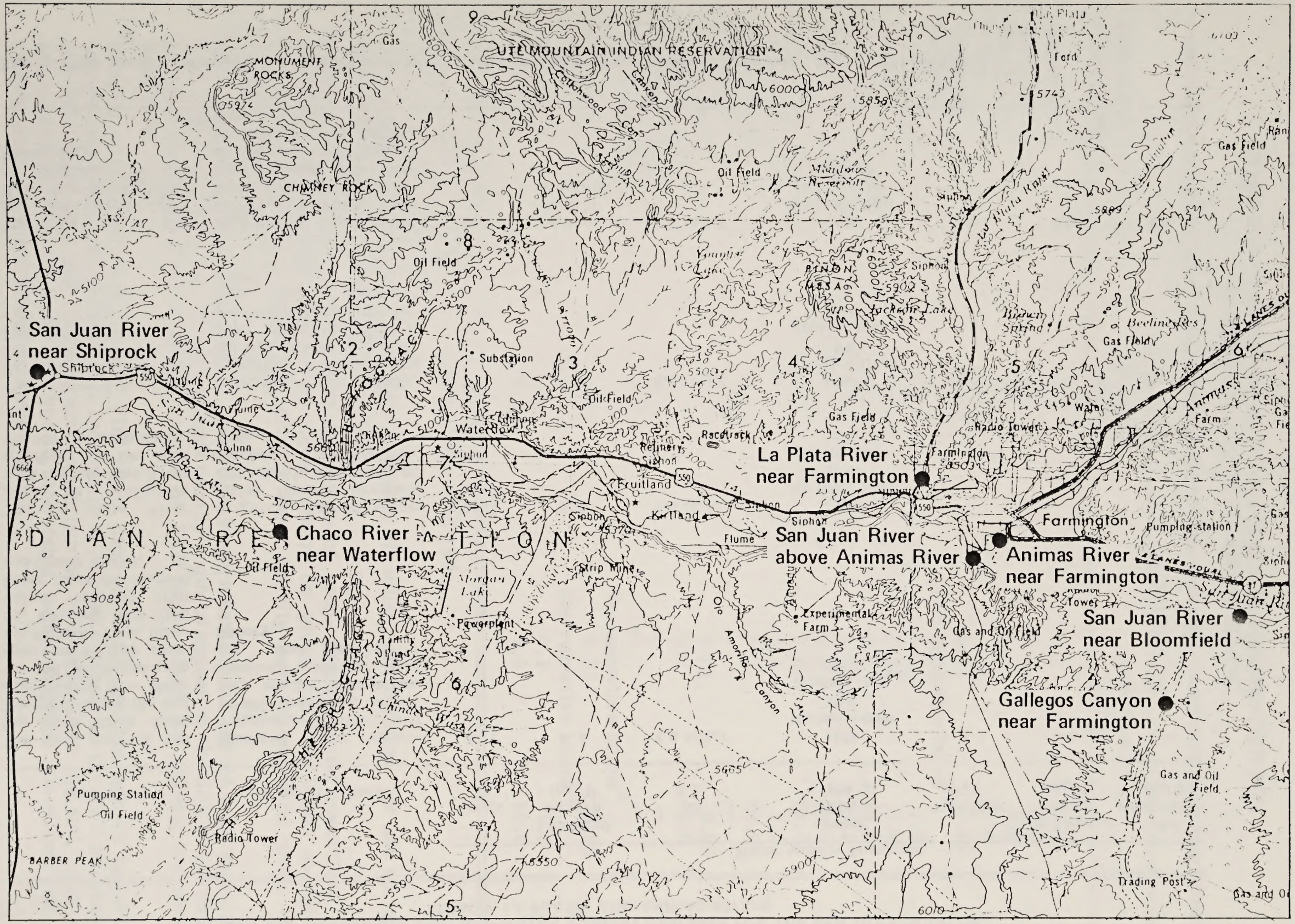


Figure 3-1. LOCATIONS OF STATIONS FROM WHICH WATER QUALITY DATA HAVE BEEN COLLECTED

Table 3-2. BENEFICIAL USES AND WATER QUALITY CRITERIA FOR THE SAN JUAN, MANCOS, CHACO, LA PLATA, AND ANIMAS RIVERS

Location	Designated Uses	Water Quality Standards						
		Temp. °C	Dissolved Oxygen (mg/l)	pH S.U.	Fecal Coliforms #/100 ml	Turbidity FTU	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)
The main stem of the San Juan River from the point where the San Juan leaves New Mexico and enters Colorado upstream to New Mexico Highway 17 at Blanco, and any flow that enters the San Juan River from the Mancos and Chaco Rivers.	Industrial water supply, irrigation, livestock and wildlife watering, secondary contact recreation, marginal coldwater fishery, and warmwater fishery.	32.2	5.0	6.6 to 8.8	1000 No more than 10% greater than 2000	---	---	---
The La Plata River from its confluence with the San Juan River upstream to the New Mexico-Colorado line.	Irrigation, limited warmwater fishery, livestock and wildlife watering, and secondary contact recreation.	32.2	5.0	6.6 to 8.8	1000 No more than 10% greater than 2000	---	---	---
The Animas River from its confluence with the San Juan upstream to U.S. 550 at Aztec.	Industrial water supply, irrigation, livestock and wildlife watering, marginal coldwater fishery, secondary contact recreation, and warmwater fishery.	27	5.0	6.6 to 8.8	1000 No more than 10% greater than 2000	---	---	---
The main stem of the San Juan River from New Mexico Highway 17 upstream to the Navajo Dam.	High-quality coldwater fishery, irrigation, livestock and wildlife watering, municipal and industrial water supply and secondary contact recreation.	20	6.0 or 85% of saturation	6.6 to 8.8	100 No more than 10% greater than 200	10	7.0	0.1

Source: New Mexico Water Quality Standards as adopted by the New Mexico Water Control Commission, WQCC 81-1, 6/4/81.

Table 3-3. WATER QUALITY CRITERIA RECOMMENDED FOR LIVESTOCK AND IRRIGATION USAGE

Parameter (Total Form)	Criterion For Livestock (mg/l)	Irrigation[a] (mg/l)	
Aluminum	5.0	5.0	20.0
Arsenic	0.2	0.1	2.0
Beryllium	—	0.1	0.5
Boron	5.0	0.75	2.0
Cadmium	0.05	0.01	0.05
Chlorides	—	See narrative below[b]	
Chromium	1.0	0.1	1.0
Cobalt	1.0	0.05	5.0
Copper	0.5	0.2	5.0
Fluoride	2.0	1.0	15.0
Iron	—	5.0	20.0
Lead	0.1	5.0	10.0
Lithium	—	2.5	2.5
Manganese	—	0.2	10.0
Mercury	0.01	—	—
Molybdenum	—	0.01	0.05
Nickel	—	0.2	2.0
Nitrate nitrogen	100.0	—	—
Nitrite nitrogen	10.0	—	—
SAR	—	See narrative below[c]	
Selenium	0.05	0.02	0.02
TDS	3000	See narrative below[d]	
Vanadium	0.1	0.1	1.0
Zinc	25.0	2.0	10.0

Source: National Academy of Science 1973, EPA 1976.

[a]Left column: for waters used continuously on all soils; right column: for use up to 20 years on fine-textured soils of pH 6.0-8.5.

[b]Permissible chloride levels depend upon type of crop, environmental conditions, and management practices. A single value cannot be given, and no limits should be established, because detrimental effects from salinity per se ordinarily deter crop growth first.

[c]Soils have individual responses to reduction in permeability as the SAR or calculated SAR values increase, but adverse effects usually begin to appear as the SAR value passes through the range from 8 to 18. Above an SAR value of 18 the effects are usually hazardous.

[d]In spite of the fact that (1) any TDS limits used in classifying the salinity hazard of waters are somewhat arbitrary; (2) the hazard is related not only to the TDS but also to the individual ions; and (3) no exact hazard can be assessed unless the soil, crop, and acceptable yield reductions are known, the table below suggests classifications for general purposes for arid and semiarid regions.

Table 3-3. WATER QUALITY CRITERIA RECOMMENDED FOR LIVESTOCK AND IRRIGATION USAGE (concluded)

Classification	TDS, mg/l	Ec, mmhos/cm
Water for which no detrimental effects are usually noticed	500	0.75
Water that can have detrimental effects on sensitive crops	500-1000	0.75-1.50
Water that can have adverse effects on many crops: requires careful management practices	1000-2000	1.5-3.0

Table 3-4. WATER QUALITY CRITERIA RECOMMENDED FOR STEAM GENERATION AND COOLING IN HEAT EXCHANGERS AT THE POINT OF USE

Water Quality Characteristic	Boiler Feedwater	Cooling Water Makeup for Recirculation
Silica	0.01	50
Aluminum	0.01	0.1
Iron	0.01	0.5
Manganese	0.01	0.5
Calcium	0.01	50
Magnesium	0.01	a
Ammonia	0.07	a
Bicarbonate	0.5	24
Sulfate	b	200
Chloride	a,b	500
Dissolved Solids	0.5	500
Copper	0.01	a
Zinc	0.01	a
Hardness	0.07	650
Alkalinity	1	350
pH (units)	8.8-9.4	a
Methylene Blue Active Substances	0.01	1.0
Carbon Tetrachloride Extract	a,c	1
Chemical Oxygen Demand (COD)	1	75
Hydrogen Sulfide	a	a
Dissolved Oxygen	0.007	a
Temperature	b	b
Suspended Solids	0.05	100

Source: NAS (1973).

[a]Accepted as received (if meeting other limiting values): has never been a problem at concentrations encountered.

[b]Controlled by treatment for other constituents.

[c]Zero, not detectable by test.

U.S. Environmental Protection Agency Primary and Secondary Drinking Water Standards are listed in Table 3-5.

Although salinity (total dissolved solids [TDS]) is not specifically regulated in the reach of the San Juan River covered in Table 3-1, numerical salinity criteria have been established for three points farther downstream along the Colorado River, as follows: 723 mg/l below Hoover Dam, 747 mg/l below Parker Dam, and 879 mg/l at Imperial Dam. Although these criteria have been exceeded historically, they have not been exceeded since their original adoption in 1974. A report entitled "1978 Revision - Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control--Colorado River System" (Colorado River Basin Salinity Control Forum 1978) made no changes in these numeric salinity criteria at the three lower mainstem stations.

3.3 EXISTING WATER QUALITY

In general, the quality of San Juan River water in the reach between Bloomfield and Shiprock is good enough to protect the designated uses of the river in this area. As Table 3-1 shows, though, the various tributary inputs to the San Juan in this area tend to degrade its quality. Such degradation is most evident in comparing TDS concentrations at Bloomfield and Shiprock (time-averaged TDS of 266 mg/l at Bloomfield and 449 mg/l at Shiprock). Measurable water quality degradation occurs even in the short reach from Bloomfield to Farmington. This discussion points out the major water quality concern (i.e., increasing salinity) in the San Juan Basin and the whole Colorado River Basin. Two processes contribute to increases in salinity: salt loading and salt concentrating. Salt loading (the addition of salts to the water system) is caused by irrigation return flows, natural sources, and municipal and industrial wastewaters. Salt concentrating (the reduction of the amount of water available for dilution of existing salts in the river system) results from consumptive use of water.

Calcium is the dominant cation in San Juan River waters, followed by sodium, magnesium, and potassium. Sodium is the dominant cation in several of the tributaries (i.e., Gallegos Canyon, La Plata and Chaco rivers) during

Table 3-5. U.S. EPA DRINKING-WATER QUALITY STANDARDS

Constituent	Primary Drinking-Water Standard[a]	Secondary Drinking-Water Standard[a]
Arsenic	0.05	
Barium	1.0	
Cadmium	0.01	
Chloride		250
Chromium	0.05	
Coliform Bacteria	1 colony/100 ml[b]	
Color		15 color units
Copper		1.0
Corrosivity		noncorrosive[c]
Fluoride	2.0[d]	
Foaming agents		0.5
Iron		0.3
Lead	0.05	
Manganese		0.05
Mercury	0.002	
Nitrate (as N)	10.0	
Odor		3 threshold odor units
Organic Chemicals-Herbicides		
2,4-D	0.1	
2,4,5-TP	0.01	
Organic Chemicals-Pesticides		
Endrin	0.0002	
Lindane	0.004	
Methoxychlor	0.1	
Toxaphene	0.005	
pH		6.5-8.5 units
Radioactivity		
Ra-226 + Ra-228[e]	5 pCi/l	
Gross Alpha Activity	15 pCi/l	
Tritium	20,000 pCi/l	
Sr-90	8 pCi/l	
Selenium	0.01	
Silver	0.05	
Sodium		f
Sulfate		250
Total Dissolved Solids		500
Turbidity	1 turbidity unit[g]	
Zinc		5.0

[a] All concentrations in mg/1 unless otherwise noted.

[b] The standard is a monthly arithmetic mean. A concentration of 4 colonies/100 ml is allowed in one sample per month if fewer than 20 samples are analyzed, or in 20 percent of the samples per month if more than 20 samples are analyzed.

[c] The corrosion index is to be chosen by the state.

[d] The fluoride standard is temperature-dependent. This standard applies to locations where the annual average of the maximum daily air temperature is 58.4°F to 63.8°F.

[e] The standard includes radiation from Ra-226 but not radon or uranium.

[f] No standard has been set, but monitoring of sodium is recommended.

[g] Up to five turbidity units may be allowed if the supplier of water can demonstrate to the state that higher turbidities do not interfere with disinfection.

parts of the year. The most abundant anion is sulfate, followed closely by bicarbonate; chloride concentrations are generally low, but they increase at a greater rate than the other anions as one moves downstream along the San Juan River.

Both the composition and concentrations of dissolved solids in the San Juan River vary with flow. Ion concentrations tend to increase as flow decreases. Chemical composition generally shifts: calcium bicarbonate dominates during high flow periods, and calcium sulfate dominates during medium and low flows, when ground-water discharge is a greater component of the base flow (EPA 1979).

A comparison of the data in Table 3-1 with the state water quality standards in Table 3-2 indicates that (1) maximum temperatures have been exceeded in the La Plata and Chaco rivers; (2) minimum dissolved oxygen standards have not been exceeded at these stations; and (3) maximum pH values occasionally exceed the maximum allowable pH value of 8.8. As shown in Table 3-2, specific state water quality standards in these waters have been adopted for temperature, dissolved oxygen, pH, and fecal coliforms.

Suspended sediment concentrations are high and increase in the downstream direction. Observed suspended sediment concentrations in the Chaco River are highest of all. Hardness values vary from soft to very hard. Nutrient concentrations increase downstream along the San Juan River, and they are much higher in the tributary inflows. Fluoride concentrations have occasionally exceeded irrigation water quality criteria in the San Juan and its major tributaries, and consistently exceed both irrigation and livestock watering criteria in the Chaco River inflow. Boron concentrations in the Chaco River inflow consistently exceed both the irrigation and livestock watering quality criteria.

Iron and manganese concentrations are generally high, with the highest observed values occurring in the Chaco River inflow. Almost all the measured iron and manganese were found in particulate form. As with suspended sediment, trace element concentrations also tend to increase downstream along the San Juan River. As with iron and manganese, only very small percentages of the observed concentrations were dissolved. In some cases, the data in Table 3-1 indicate that dissolved metal concentrations are greater than total metal concen-

trations. This situation results from the averaging of data sets that include unpaired dissolved metal data as well as pairs of total and dissolved metal concentrations. When the values of the unpaired dissolved metal samples were greater than the values of the paired concentrations, the ranges and averages of the dissolved concentrations were greater. The highest concentrations of arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc were found in the Chaco River inflow. Arsenic, cadmium, chromium, copper, and selenium concentrations exceeded irrigation water quality standards; arsenic, copper, and lead concentrations occasionally exceeded the criteria concentrations for livestock and wildlife watering.

3.4 FUTURE WATER QUALITY

In general, it can be predicted that the water quality of the San Juan River below Farmington will decrease (EPA 1979). Potential changes in San Juan Basin water quality and their probable causes have been summarized (EPA 1979) and are listed below:

Point source discharge of pollutants from energy development sites will not pose a problem to water quality in the Basin if discharge limitations are enforced. Rather, nonpoint pollution from such sources as stack emissions, airborne dust, and subsurface drainage will be the major contributors. Regular monitoring for potential violations from energy development operation sites is required. Potential is quite high for deposition of coal dust on the bottom of the San Juan Arm of Lake Powell. If this should occur, changes in the near-bottom environment could have drastic and adverse impact on the ecology of this productive water body.

Secondary development pollution impacts are likely to become the major contributing problem to water quality in the San Juan River. Increases in organic pollutants and TDS levels from urban runoff and hydraulic modifications and pollution from the expanding use of water conditioners are expected.

The impact of the Navajo Indian Irrigation Project will be more severe than that from energy development alone. Consumptive water use, salt and nutrient loading of return flow waters, increased erosion, and agricultural by-product wastes could all be major impacts associated with this program.

In addition to the long-term trends, an increased number of pollution "episodes" (spills, etc.) are expected as a result of the increased transport of energy products in the area and the likelihood of flood runoffs from waste disposal, cooling system, or mining sites. These brief, but massive,

events could cause both short- and long-term effects that would be disastrous to both the ecology and the economy of the area.

Although water quality in the San Juan Basin and below is expected to decrease, quantitative predictions of such changes for most water quality parameters are not available. However, quantitative predictions of the effect of selected projects on downstream TDS concentrations have been made (USBR 1981). Present and predicted TDS concentrations at several points on the San Juan River and farther downstream along the Colorado River are shown in Table 3-6. As the table shows, two baselines need to be considered during each predicted year because a number of water quality control projects have been proposed to improve the quality of the Colorado River and its tributaries. The "1978 Revision - Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control - Colorado River System" recommends that prompt construction and operation of the three salinity control units authorized by Section 202, Title II, of Public Law 93-320--namely the Paradox Valley, Grand Valley, and Las Vegas Wash Units--be undertaken, with additional planning being required before construction of Las Vegas Wash.

Paradox Valley is a collapsed salt anticline in southwestern Colorado that contributes a high TDS brine to several tributaries (West and East Paradox creeks) of the Dolores River. Flow through the Valley is estimated to increase downstream salt load by an average of 205,000 tons annually. In order to reduce downstream salt loading, present plans are to pump the brine from a well field to a nearby hydrogen sulfide stripping plant. The treated brine and sulfur would then be pumped to an evaporation pond or deep-well injection site for disposal. Disposal into a pipeline collection system is also being considered. Pilot studies on hydrogen sulfide removal, evaporation, and brine well-field pumping are already completed or are well underway. Deep-well injection studies are presently underway.

The Grand Valley, carved into the Mancos Shale Formation (a high-salt-bearing marine shale) by the Colorado River and its tributaries, is estimated to contribute an average of about 780,000 tons of salt annually to the Colorado River. Most of these salts are leached from the soil and underlying Mancos Shale by deep percolation and seepage from water delivery systems, and are washed into the river by ground-water inflow. In order to reduce this downstream

Table 3-6. EXISTING AND FUTURE TDS CONCENTRATIONS IN AND DOWNSTREAM OF THE SAN JUAN RIVER WITH AND WITHOUT SALINITY IMPROVEMENT PROJECTS[a]

Location	TDS Concentrations, mg/l						
	Average	1990		2000		2010	
	1941-1978	A	B	A	B	A	B
San Juan River, near Archuleta	163	178	178	176	176	177	177
San Juan River, near Bluff	453	627	627	763	746	760	743
Colorado River, below Hoover Dam	691	697	672	766	663	805	681
Colorado River, below Parker Dam	696	730	706	808	703	851	721
Colorado River, at Imperial Dam	769	859	824	969	837	1019	859

[a]All TDS concentrations are flow-weighted averages produced using the U.S. Bureau of Reclamation's Colorado River Simulation System (CRSS). Estimates in column A assume no salinity improvement projects are undertaken; in column B, that such projects are undertaken.

contribution, the Government Highline Canal is being lined, laterals will be placed in pipe, and some on-farm improvements will be made.

Las Vegas Wash is a natural drainage channel providing the only surface-water outlet for the entire Las Vegas Valley. The wash conveys surface runoff and wastewater to Las Vegas Bay, an arm of Lake Mead. Return flows to the wash, consisting of treated sewage effluent, industrial cooling water, urban irrigation, and agricultural drainage, leach salts from the soil as they flow into and through Las Vegas Wash. A salinity control plan will be finalized in late 1982. In general, all these projects are proceeding at the pace outlined in "Progress Report No. 10 - Quality of Water, Colorado River Basin" (USBR 1981).

In addition, the report recommends authorization and construction of the Meeker Dome Unit and 10 of the 12 units listed in Section 203a(1), Title II of Public Law 93-320 or their equivalents after receipt of favorable planning reports. These projects are needed because, as shown in Table 3-6, the numerical salinity criteria are expected to be exceeded in future years without some control measures. As Table 3-6 also shows, these control measures have the greatest impact at locations well downstream along the Colorado River.

3.5 WATER QUALITY IMPACTS

3.5.1 Construction

Construction of the water diversion facilities would involve activities both in and adjacent to the San Juan River. Headgate construction would require the placement of a cofferdam during construction, which would be removed after construction was completed. Other facilities that would be constructed adjacent to the San Juan River include settling channels, trashracks, a pumping plant forebay, a pumping plant, and a discharge pipeline. Construction of flood-protection facilities may involve dikes or elevation of all facilities above maximum flood levels. Potential surface water quality effects on the San Juan River resulting from these construction activities include increases in suspended sediment loading and water quality degradation resulting from spills of gasoline and diesel fuel, cleaning solvents, and wastewaters from concrete pouring.

Increased suspended sediment loading to the San Juan River could occur during cofferdam placement and removal as well as from rainfall-induced erosion during construction of adjacent buildings. It is expected that cofferdam placement and removal would disturb river sediments. It is virtually impossible to predict the quantity of suspended sediment produced during these operations.

For a rough estimate of impacts, it is possible to develop an equation (WCC 1981) that calculates the net downstream transport of suspended material. This equation, as below, estimates the downstream suspended sediment concentration along the centerline of a plume resulting from the instantaneous discharge of material into the stream. The equation is based on a physical model assuming that material moves downstream at the same velocity as the current, disperses laterally at a rate of 0.5 cm/sec (Okubo 1971) and settles without resuspension.

$$C_x = \frac{R_{md}}{(0.5)(x)(d)} e^{-[(2V_s/d)(x/u)]}$$

where R_{md} = Mass discharge rate
x = Downstream distance
u = Current velocity
V_s = Settling velocity
d = Depth of river

A mass discharge rate can be estimated by assuming that a dragline or backhoe with a 1.5-cubic-yard capacity is used 90 times per hour (Carson 1961). Recent investigations (Scheubel et al. 1978) indicate that an average of 1 percent of the dredged material would be suspended in the water column at or adjacent to a typical dredge and fill site. If it is assumed that the weight of sediment is 80 lb/ft^3, the instantaneous loss rate would be about 367,000 mg/sec.

Most of the lost particles would be of the smaller size range. On the basis of the bed-material particle-size distributions available (STORET 1981) for the San Juan River in this reach, most of the material lies within the sand size ranges (0.0625 mm to 2.0 mm). A conservative estimate for the mean size of lost particles is 0.06 mm. The settling velocity of this particle (at 20°C) would be about 0.3 cm/sec (ASCE 1975). An average depth of 3 feet (91 cm) and a current value of 1.2 ft/sec (36.6 cm/sec) will be assumed. Using these

assumptions, the predicted concentration of suspended sediment as a function of downstream distance is shown in Table 3-7.

As shown in the table, almost all of the suspended material would return to the bed within a few hundred feet downstream. These estimates generally tend to estimate higher initial downstream concentrations because it has been assumed that most of the dredged or fill materials lost to the stream would be in the smaller size ranges. On the other hand, a small fraction of finer materials could travel downstream a greater distance before settling entirely to the stream bottom (assuming no resuspension). For example, a worst-case estimate for transport of a fine silt fraction (diameter of 0.008 mm and a settling velocity of 0.005 cm/sec) would be over 20,000 feet downstream.

The instantaneous mass discharge rate of 367,000 mg/sec (about 0.8 lb/sec) can be compared with the average sediment load carried in the river. While no data are available on the sediment load at the proposed diversion, sediment load data are available for the San Juan River at Bloomfield (sediment load at the diversion is expected to be somewhat greater than at Bloomfield). The arithmetic average of 35 observations made during the 1978 and 1979 water years is about 218 lb of sediment load per second. The geometric mean value of these observations is about 37 lb/sec. The lowest value observed was 1.3 lb/sec, and the highest value was about 3700 lb/sec. Clearly, cofferdam placement and removal would have little or no effect on the suspended sediment load of the San Juan River.

During this same period (water years 1978 and 1979), suspended sediment concentration measurements ranged from 43 to 23,500 mg/l. Consequently, the projected incremental suspended sediment increases due to construction activities may increase stream suspended sediment and turbidity levels above background levels in the immediate areas of the disturbance. The majority of these suspended materials would settle within 1000 feet of the disturbance, although the very small fraction of finer particles could travel up to 20,000 feet downstream.

In conclusion, the effect upon surface-water quality due to construction activities would not be significant because: (1) the activities are temporary

Table 3-7. ESTIMATED INCREASE IN LEVELS OF SUSPENDED SOLIDS RESULTING FROM DREDGING ACTIVITIES IN THE SAN JUAN RIVER

Downstream Distance (feet)	Concentration (mg/l)
50	4025
100	1530
200	442
500	34
1000	1.1

in nature and no permanent water quality degradation occurs, (2) existing short-term levels of suspended solids in the river on occasion exceed the temporary level estimated to occur during construction, and (3) the great majority of disturbed sediments would settle within short distances downstream.

Before the construction activities described above can begin, a permit must be obtained from the U.S. Army Corps of Engineers (COE). The COE is responsible for reviewing applications involving the discharge of dredged or fill materials into the waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972. Under this program, the COE is able to grant three kinds of permits. A nationwide permit is automatically granted to an applicant whose project concerns (1) utility-line stream crossings; (2) bank stabilization activities of limited extent and volume; (3) minor road-crossing fills; (4) fills placed incidental to the construction of bridges in tidal waters; and (5) repairs, rehabilitation, or replacement of any previously authorized, currently serviceable fill, or of any currently serviceable fill discharged prior to the requirement for authorization. The bank stabilization activities on the San Juan River may possibly be permitted under the nationwide permit program.

General permits are granted to those projects that, in the judgment of the COE district engineer, meet the following criteria: They (1) are substantially similar in nature to the type of project for which the district engineer has previously granted general permits; (2) cause only minimal adverse environmental impact when performed separately; (3) will have only a minimal adverse cumulative effect on the environment; and (4) meet other additional conditions as required by the district engineer. General permits in this district are granted to discharges of dredged and fill materials for construction activities at existing diversion facilities. Individual permits are required for new facilities not covered under the nationwide or general permit authority. It would appear that such an individual permit would be required for the proposed diversion facilities on the San Juan River.

An estimate of the soil loss caused by rainfall-induced erosion occurring during the construction of the diversion facilities was made using the Universal Soil Loss Equation (USLE) (Wischmeier and Smith 1978). The USLE is an empirical

equation which states that annual soil loss per acre can be calculated as the product of a number of factors dependent on rainfall intensity, soil properties, topography, and erosion control practices. While the USLE is not applicable to individual storms, a method exists (Wischmeier and Smith 1978) whereby the soil loss for a shorter period than a year can be estimated. Application of the equation to this instance indicates that total soil loss during the high-rainfall period from June to October is likely to be about equal to the lowest daily sediment load of 55 tons (observed during 35 measurements in 1978 and 1979 at Bloomfield) carried by the San Juan River.

The USLE factors chosen in the equation were as follows: (1) R (the rainfall/runoff factor) was assumed equal to (30) x (0.88) (a factor to adjust annual soil loss to soil loss for the June through October period), (2) k (the soil erodability factor) was assumed equal to 0.10, (3) LS (the topographic factor) was assumed equal to 1.0, (4) C (the cover and management factor) was assumed equal to 1.0, and (5) P (the support practice factor) was assumed equal to 1.0 also. The worst-cast assumption that sediment loss was equal to sediment yield was also made. Given these assumptions, the total amount of suspended material lost to the river during June-October would generally be only a small percentage of the material carried by the river in one day. Consequently, the sediment lost from the construction activities would have little or no observable effect on total sediment load in the San Juan River.

Water quality degradation of both surface and ground waters could result from spills of gasoline, diesel, cleaning solvents, wastewaters from concrete-pouring activities, and other waste solutions used or produced during construction. While specific mitigation measures have not been suggested, little or no direct contamination of surface waters is expected. (See the Suggested Mitigation Section for recommended mitigation measures.) Indirect surface-water contamination could occur if the construction dewatering withdrew contaminated ground water resulting from spillage and subsequently discharged the water to the river. While the probability of such a scenario is low, extra care should be taken to ensure that any liquid spill is of negligible quantity. Because concrete trucks would be owned and operated by an outside firm, cleaning of trucks would be done off-site. In addition, major maintenance activities would also occur off-site.

3.5.2 Operation

Downstream water quality degradation could result from flooding of the diversion facilities, disposal of collected suspended sediment, and the net reduction in the quantity of downstream dilution water due to the withdrawal for power plant cooling water. Flooding of the diversion facilities is likely to have little or no effect on downstream water quality, as large quantities of fuels, lubricating oils, cleaning solvents, and/or any other potentially hazardous materials are not likely to be stored on-site.

As described in the Project Description Technical Report, settling channels would be used to collect suspended sediment contained in the flow diverted from the San Juan River. According to the present design of the facility, this material would not be removed from the physical confines of the river and would be sluiced downstream by the flow of the river. According to the regulations of the U.S. EPA National Pollutant Discharge Elimination System (NPDES) permit system, discharge of suspended material physically removed from water diverted from the San Juan River would not be permitted. As noted above, the applicant has stated that his design would allow the sediment content of the river to be reduced within the physical confines of the river.

As mentioned earlier, salinity buildup in the Colorado River Basin is a problem of great importance. While the proposed power plant is not expected to discharge any liquids into the San Juan River or its tributaries, the withdrawal of upstream San Juan River water would cause downstream salinity to increase somewhat. This salt-concentrating effect, as previously mentioned, is primarily caused by the higher salinity of downstream inflows. Consequently, when the amount of higher-quality upstream water is reduced, the quality of the downstream water tends to decrease further.

The proposed withdrawals would have some effect farther downstream. Convenient locations to observe such effects include the Colorado River below Parker Dam, Hoover Dam, and Imperial Dam. The U.S. Bureau of Reclamation (USBR), Colorado River Simulation System (CRSS), projections for the year 2010 with and without the proposed salinity control features can be used to evaluate the potential average annual downstream effects of the proposed

withdrawal. The salinity increases associated with two levels of withdrawal for NMGS (i.e., 20,000 and 35,000 AFY) at these downstream locations are shown in Table 3-8. The predicted maximum annual average salinity increase in the Colorado River at Imperial Dam ranges from 3.1 to 4.0 mg/l.

As suggested above, the salinity changes presented in Table 3-6 were calculated using the projections of the USBR's CRSS model and average TDS values for the San Juan River above Farmington. A simple mass balance model was then used to estimate downstream salinity changes when a withdrawal of 20,000 or 35,000 acre-feet at a time-weighted average of 306 mg/l occurred. The derivation of an appropriate equation and an example problem are shown in Table 3-9.

As discussed previously, the respective salinity standards on the Colorado River below Hoover Dam, Parker Dam, and Imperial Dam are 723, 747, and 979 mg/l. If salinity control programs are not implemented, salinity levels are likely to exceed these standards by the year 2010. Therefore the salinity level increases due to NMGS would exacerbate this violation of salinity standards. On the other hand, the salinity increases caused by NMGS by the year 2010 would not cause the standards to be exceeded if all the presently proposed salinity control projects were implemented. It is the view of the USBR that the salinity increases caused by consumptive uses of water are allowable, as they are the inevitable result of each state's right to use its share of Colorado River Basin waters. The USBR is then responsible for design and implementation of salinity control programs so that the states can continue to use their water.

The USBR (1981) has studied the economic impact of increasing salinity in the Colorado River on Arizona and Southern California users. It is estimated that the annual damages to the Lower Basin water users are $343,000 (in 1976 dollars) for each 1 mg/l rise in salinity concentration at Imperial Dam. The damage is about equally divided between municipal and agricultural users, with municipal damages being slightly larger. Industrial damages are considered relatively small and are included in municipal costs. Salinity affects agricultural use primarily by reducing yields, limiting types of crops, and in some cases affecting soil structure. In the case of municipal use, increases in salt concentration and hardness lead to added consumption of soap and detergents, corrosion

Table 3-8. AVERAGE ANNUAL SALINITY CHANGES AT THREE DOWNSTREAM LOCATIONS IN THE YEAR 2010 WITH AND WITHOUT SALINITY CONTROL PROGRAMS AND AT TWO LEVELS OF WITHDRAWAL

Location	Without Salinity Control					With Salinity Control				
	Base TDS	20,000 AF		35,000 AF		Base TDS	20,000 AF		35,000 AF	
		in mg/l	in %	in mg/l	in %		in mg/l	in %	in mg/l	in %
Colorado River, below Hoover Dam	805	1.0	0.12	1.8	0.22	681	0.76	0.11	1.3	0.20
Colorado River, below Parker Dam	851	1.4	0.17	2.5	0.30	721	1.1	0.16	2.0	0.27
Colorado River, at Imperial Dam	1019	2.3	0.22	4.0	0.39	859	1.8	0.21	3.1	0.37

See Table 3-9 for the methodology used to make these predictions.

Table 3-9. METHOD USED TO CALCULATE TDS CHANGES AT DOWNSTREAM LOCATIONS RESULTING FROM SAN JUAN RIVER DIVERSION

1. Derivation of Mass Balance Equation

Mass Flow Rate After Withdrawal	=	Mass Flow Rate Before Withdrawal	-	Mass Flow Loss Due to Withdrawal

$$Q_{AW}\ C_{AW} = Q_{BW}\ C_{BW} - Q_W\ C_W \qquad (1)$$

where

Q_{AW} = Downstream flow after withdrawal

C_{AW} = Downstream TDS concentration after withdrawal

Q_{BW} = Downstream flow before withdrawal (based on CRSS projections)

C_{BW} = Downstream TDS concentration before withdrawal (based on TDS concentrations)

Q_W = PNM withdrawal from San Juan River

C_W = Average time-weighted TDS concentration at the PNM diversion facility

Substituting $Q_{AW} = Q_{BW} - Q_W$ into (1) and rearranging, the following equation is derived:

$$C_{AW} = \frac{Q_{BW}\ C_{BW} - Q_W\ C_W}{Q_{BW} - Q_W} \qquad (2)$$

The changes in downstream TDS concentration are then

$$C = C_{AW} - C_{BW} \qquad (3)$$

2. An example of the use of equations 2 and 3 is as follows for the case of a 35,000 ac-ft withdrawal during 2010 without salinity control. Concentration changes at Imperial Dam will be considered.

Table 3-9. METHOD USED TO CALCULATE TDS CHANGES AT DOWNSTREAM LOCATIONS RESULTING FROM SAN JUAN RIVER DIVERSION (concluded)

At Imperial Dam

Q_{BW} = 6,310,000 ac-ft C_{BW} = 1,019 mg/l

Q_{W} = 35,000 ac-ft C_{W} = 306 mg/l

$$C_{AW} = \frac{(6,310,000)(1,019) - (35,000)(306)}{(6,310,000 - 35,000)} = 1,023$$

$$C = C_{AW} - C_{BW} = 1023 - 1019 = 4.0 \text{ mg/l}$$

Values for the downstream flows and qualities were obtained from CRSS projections listed in Table 3-6 and below.

Average Flow Conditions at Downstream Locations
Using CRSS Projections for 2010, in ac-ft

Location	Without Salinity Control	With Salinity Control
Colorado River Below Hoover Dam	9,996,000	9,912,000
Colorado River Below Parker Dam	7,557,000	7,405,000
Colorado River Below Imperial Dam	6,310,000	6,202,000

and scaling of metal water pipes and water heaters, accelerated fabric wear, added water-softening costs, and occasionally to abandonment of the water supply.

3.5.3 Alternative Intake Site

It is expected that the downstream salinity changes would be slightly greater if water is removed at Bloomfield rather than above the Animas River at Farmington. This results from the slightly higher-quality water generally found in the San Juan River at Bloomfield.

4.0

GROUND-WATER WITHDRAWAL FROM WESTWATER CANYON MEMBER

The construction and operation of the facilities necessary to withdraw ground water from the Westwater Canyon Member in the vicinity of the proposed plant site might affect both the surface- and ground-water quality there as well as at points of recharge. Surface waters downstream of the area of recharge might be affected by reductions in flow, while the Westwater Canyon Member might be adversely affected by the leakage of poorer-quality ground water from other aquifers. These potential impacts are examined below in light of present water quality and the environmental effects of this element of the proposed project.

4.1 BASELINE WATER QUALITY

The surface-water quality of the affected area is described in Section 5.1. In general, surface-water quality is poor during low flows but tends to improve during high flows for most dissolved parameters. For suspended sediment, the reverse is usually true; that is, suspended loads and concentrations are very high during high flows and much lower during low flows. Even in times of low flow, though, suspended sediment concentrations are characteristically high.

As mentioned in the Hydrology Technical Report, there are a number of aquifers in the San Juan Basin. A summary of the major water quality characteristics of many of these aquifers (Table 4-1) shows extremely wide variations in ground-water quality. In general, the greatest variations seem to be in the near-surface aquifers, with the greatest observed variations found in the alluvium and the Pictured Cliffs Sandstone. Of particular interest, of course, is the quality of water found in the Westwater Canyon Member of the Morrison Formation and the adjacent aquifers that may contribute leakage to the Westwater Canyon Member as its pressure is reduced. Adjacent aquifers include the overlying Dakota Sandstone and the underlying Entrada Sandstone.

Table 4-1. A SUMMARY OF THE CHEMICAL QUALITY OF MAJOR AQUIFERS IN THE SAN JUAN BASIN

Aquifer	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium & Potassium (Na+K)	Bicarbonate (HCO_3)
Alluvium	4.1-63	0-6.6	4-2870	0.8-2040	5.5-12,000	34-1000
San Jose Formation	7.6-28	0.02-14	1.6-365	0-67	29-745	120-814
Nacimiento Formation	14-22	0.02-0.58	0-385	0-50	3-2415	0-478
Ojo Alamo Sandstone	9.6-39	0-2.1	1.6-548	0-126	23-788	0-888
Pictured Cliffs Sandstone	11-20	0-0.24	1.9-425	1-217	50-16,600	209-2400
Cliff House Sandstone	2.7-19	0-0.01	2.2-280	0.7-170	26-6140	0-1250
Menefee Formation	5.1-21	0-1.1	1-168	0-34	8-2620	92-1890
Point Lookout Sandstone	0.05-39	0-0.31	0-684	0.4-267	13-833	116-826
Crevasse Canyon Formation	5.5-24	0-3.6	1.3-630	0-245	0.9-1002	122-1030
Gallup Sandstone	10-38	0.02-15	1-456	0-268	16-1690	85-763
Dakota Sandstone	6.5-42	0-7.8	1.5-330	0.9-103	5.8-1430	130-1600
Westwater Canyon Member Morrison Formation	6.2-29	0-4	1.2-373	0.2-188	9.2-1430	60-1200
Bluff Sandstone	7.4-18	0-0.39	7.5-221	2.2-106	24-949	168-898
Entrada Sandstone	9.1-27	0.09	1.2-262	0.2-64	15-543	83-539
Chinle Formation	3.9-45	0-1.2	0.4-304	0.5-587	1.2-5740	34-1150
San Andres Limestone	6.7-23	0-1.2	60-266	14-128	1.2-426	161-702
Glorieta Sandstone	8.2-13	3.4-4.1	100-183	15-87	9.2-1330	184-265

Source: Cooley 1979.

Note: All concentrations in mg/l unless otherwise noted.

Table 4-1. A SUMMARY OF THE CHEMICAL QUALITY OF MAJOR AQUIFERS IN THE SAN JUAN BASIN (continued)

Aquifer	Sulfate (SO_4)	Chloride (C1)	Fluoride (f)	Nitrate (NO_3)
Alluvium	2.5-8890	2-27,500	0-11	0-439
San Jose Formation	71-1430	3.2-87	0.2-4.0	0-25
Nacimiento Formation	6.2-5455	1-145	0-4	0.2-5.7
Ojo Alamo Sandstone	0.4-2440	0.8-923	0.3-1.8	0-70
Pictured Cliffs Sandstone	7.3-4400	19-26,600	1.2-5.5	0-8.6
Cliff House Sandstone	350-8230	7-4210	0-8.1	0.1-2.5
Menefee Formation	1.8-3930	1.5-956	0-12	0-19
Point Lookout Sandstone	3.8-3410	2.2-113	0.2-3.7	0.1-14
Crevasse Canyon Formation	9.2-2980	1.4-94	0-2.0	0-427
Gallup Sandstone	17-2854	4-1940	0-6.8	0-40
Dakota Sandstone	7.8-3540	6-500	0.1-10	0.1-10
Westwater Canyon Member Morrison Formation	11-3540	0.8-374	0.1-4	0-200
Bluff Sandstone	17-2380	12-118	0.2-5.1	0.1-18
Entrada Sandstone	5.8-1930	5-2230	0.2-1.6	0-33
Chinle Formation	16-4110	5-9590	0.1-5.9	0-129
San Andres Limestone	11-1030	4-254	0-0.8	0-105
Glorieta Sandstone	230-637	5-1980	0.1-0.8	0-1.7

Source: Cooley 1979.

Note: All concentrations in mg/l unless otherwise noted.

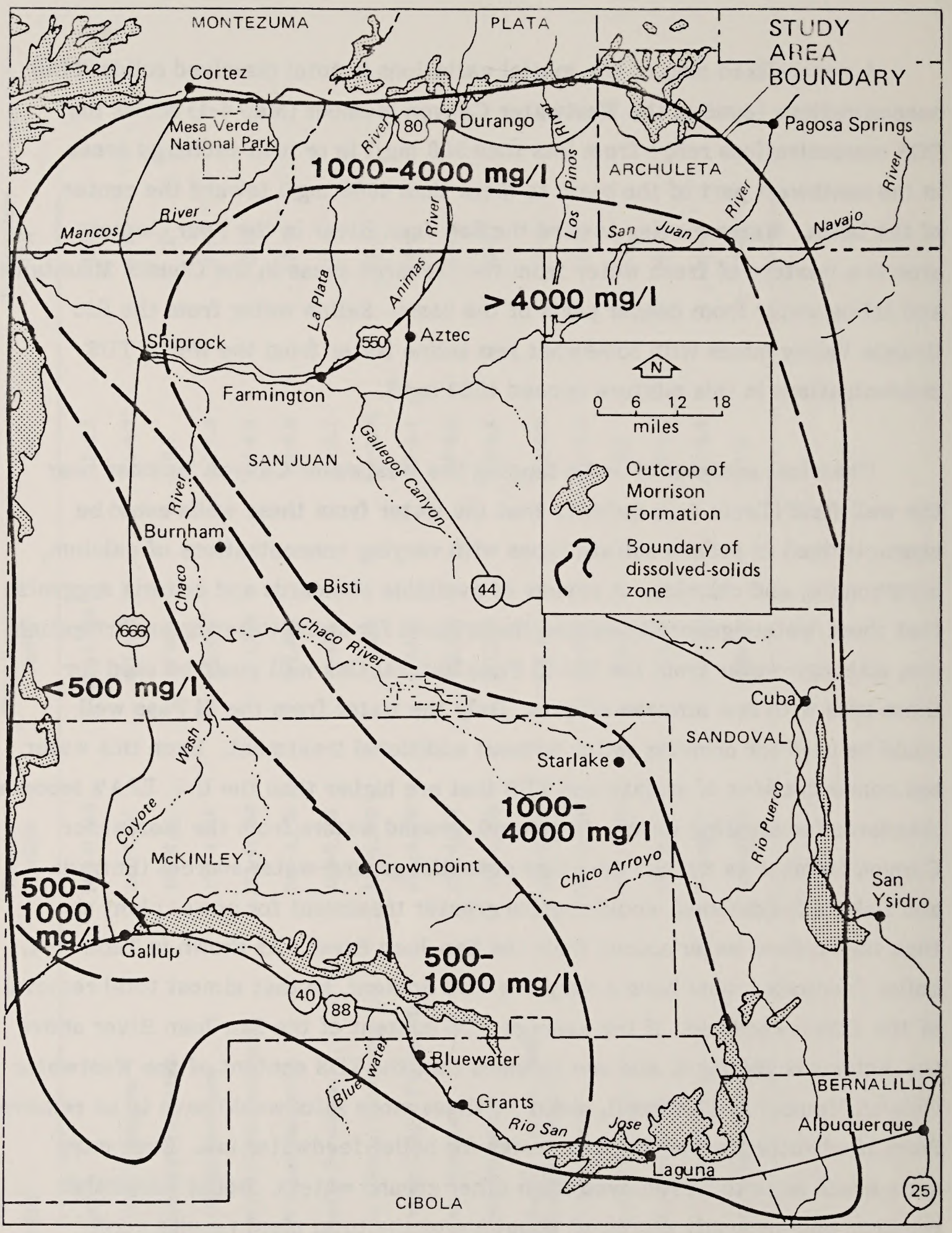
Table 4-1. A SUMMARY OF THE CHEMICAL QUALITY OF MAJOR AQUIFERS IN THE SAN JUAN BASIN (concluded)

Aquifer	Dissolved Solids	Total Hardness (units)	pH	Temperature (°C)
Alluvium	143-47,100	18-15,500	7.3-8.3	4-21
San Jose Formation	323-2,520	4-1,960	6.5-9.2	9-14
Nacimiento Formation	56-14,150	30-966	6.9	12
Ojo Alamo Sandstone	275-4,010	4-1,860	6.5-8.9	2-14
Pictured Cliffs Sandstone	383-44,200	11-1,950	7.4-9.1	3-19
Cliff House Sandstone	849-3,120	8-1,600	4.3-8.9	13-18
Menefee Formation	129-7,780	4-534	7.4-9.1	12-21
Point Lookout Sandstone	149-5,080	5-2,800	7.4-10.0	13-21
Crevasse Canyon Formation	243-4,470	4-3,100	6.8-9.1	12-20
Gallup Sandstone	285-4,400	4-2,240	7.2-8.8	9-42
Dakota Sandstone	165-5,560	9-1,080	7.2-8.4	13-23
Westwater Canyon Member Morrison Formation	168-5,560	4-1,700	7.2-9.2	14-52
Bluff Sandstone	264-3,760	20-988	7.5-8.3	11-24
Entrada Sandstone	196->5,000	4-916	9.2	17
Chinle Formation	171-6,410	3-3,170	6.8-9.1	12-20
San Andres Limestone	272-2,370	72-1,040	6.7-8.2	11-46
Glorieta Sandstone	567-4,330	412-779	7.2	13-26

A generalized map of the spatial variations in total dissolved solids (TDS) concentrations found in the Westwater Canyon Member (Map 4-1) shows that TDS concentrations range from less than 500 mg/l in or near recharge areas in the southwest part of the basin to more than 4000 mg/l toward the center of the basin. Water moving toward the San Juan River in the Four Corners area is a mixture of fresh water from the recharge areas in the Chuska Mountains and saline water from deeper parts of the basin. Saline water from the Rio Grande Valley mixes with somewhat less saline water from the west. TDS concentrations in this mixture exceed 4000 mg/l.

Chemical analyses of wells tapping the Westwater Canyon Member near the well field (Table 4-2) indicate that the water from these wells could be characterized as sodium sulfate types with varying concentrations of calcium, bicarbonate, and chloride. A review of available standards and criteria suggests that these waters generally exceed the criteria for stock watering and irrigation use, although water from the the El Paso Natural Gas well could be used for those uses with few adverse effects. Only the water from the El Paso well could be used for drinking water without additional treatment. Even this water has concentrations of sulfate and TDS that are higher than the U.S. EPA's secondary standards for drinking water. In general, ground waters from the Westwater Canyon Member as well as the other potential ground-water sources (Entrada and Dakota Sandstones) would require greater treatment for power plant use than the surface water source from the San Juan River. As shown in Table 3-4, boiler feedwater must have a very low TDS content, so that almost total removal of the TDS is required. If the average TDS content of the San Juan River above the Animas is 206 mg/l, and one assumes that the TDS content of the Westwater Canyon Member is 4458 mg/l, about 14 times more salts would have to be removed from Westwater Canyon Member water for boiler feedwater use. Even more salts would have to be removed from other ground waters. Boiler feedwater requirements probably represent about 5% of the total plant requirements.

Most of the water in the plant would be used and lost in the cooling-tower system. Higher levels of treatment would also be required if Westwater Canyon or any of the ground-water sources were used for cooling water. The major



Geology modified from:
C.H. Dane and G.O. Bachman (1965)

Source: Lyford and Freznel, 1979

Map 4-1. GENERALIZED MAP OF THE TDS CONTENT OF WATER IN THE WESTWATER CANYON MEMBER IN THE SAN JUAN BASIN

Table 4-2. CHEMICAL ANALYSES FOR WESTWATER CANYON MEMBER WELLS

Location	21N 9W.16.230[a]		23N 14W3.130[b]	23N13W.9[b]
Name	—		El Paso NG	Apache Foshay
Date	5/5/75	1/6/76	9/29/73	8/30/73
Water Quality Parameters[c]	Concentrations			
General Constituents				
Water Temperature, °C	57	48	61	60
pH, S.U.	—	8.0	8.1	8.0
Specific Conductance (µmhos/cm/25°C)	4350	4000	1390	6060
TDS (calculated)	3600	3370	925	4458
Chemical Oxygen Demand	—	1	—	—
Suspended Solids	—	—	—	49.4
Turbidity, TTU	—	2	—	—
Alkalinity	—	—	—	—
Hardness, total ($CaCO_3$)	870	820	99	370
noncarbonate	820	770	0	—
Sodium Adsorption Ratio	11	12	11	30.2
Total Organic Carbon	—	0.7	—	—
Common Ions				
Calcium	340	320	39	141
Magnesium	5	4	0.5	4
Sodium	770	760	250	1175
Potassium	8.0	9.1	2.5	8
Iron, diss. µg/l	30	0	10	240
Manganese, diss. µg/l	300	320	-	160 (total)
Bicarbonate as HCO_3	57	60	166	264
Sulfate	2400	2200	490	2074
Chloride	14	19	17	639
Fluoride	2.3	2.8	1.0	2
Boron, µg/l	110	180	—	800
Sulfide	—	0	—	0
Nutrients				
Nitrate + Nitrite, as N	0.01	0.01	0.03	0.46
Total Organic Nitrogen, as N	0.05	0.35	—	—
Orthophosphorus, diss, as P	0.05	0.03	0.14	—
Silica, as SiO_2	30	29	43	17.9
Total Ammonia, as N	—	.39	—	—
Total Phosphorus	—	—	—	0.31
Trace Elements (µg/l)[d]				
Aluminum		40/10	—	—
Arsenic		5/5	—	—
Boron		-/180	—	800
Cadmium		10/0	—	—
Chromium		0/0	—	—
Cobalt		5/0	—	—
Copper		10/0	—	—
Iron		340/0	—	—
Lead		100/0	—	—
Lithium		280/270	—	—
Manganese		320/320	—	—
Mercury		0.1/0.1	—	—
Selenium		0/0	—	—

[a] From USGS 1976, 1977.

[b] From Shomaker 1974.

[c] All concentrations in mg/l unless otherwise noted.

[d] Total/dissolved.

parameters of interest are calcium, silica, and sulfates. Although ground waters are high in salt content, they are relatively low in calcium and silica, therefore reducing the total amount of calcium to be removed.

The high levels of sulfate may be a problem because of their potential for formation of calcium sulfate, or gypsum. Although sulfates can be removed from water by a number of processes (such as electrodialysis or reverse osmosis), treatment is not usually required because the sulfate problem is controlled by calcium removal and control on the number of times cooling-tower water is cycled through the system. Consequently, higher sulfate levels, if not reduced by treatment, tend to limit the number of cycles of cooling water through the cooling system.

High levels of carbonates can also be a problem because of the formation of an insoluble salt, calcium carbonate. However, this potential problem is easily controlled by the addition of acid to reduce the pH. High levels of chlorides can also be a problem, but their effects can be mitigated through the proper selection of piping alloys and corrosion inhibitors.

Considering the relatively small distance (6 miles) between the El Paso well and the Apache Foshay well, the observed difference in TDS levels (925 mg/l at El Paso well and 4458 mg/l at Apache Foshay) indicates the extreme variability in water quality in this aquifer. As Figure 3-1 shows, the well field lies in an area where water quality changes rapidly, from TDS levels less than 1000 mg/l to TDS levels greater than 4000 mg/l within 10 miles. It should be noted that the El Paso well lies west of the Apache Foshay well, which is several miles west-northwest of the proposed plant site, and that most of the well field lies west or southwest of the proposed plant site.

The water in the other well listed in Table 4-2 (which is located about 27 miles west-southwest of Apache Foshay) is much closer in TDS concentration to Apache Foshay than to the El Paso well. A review of ground-water flow maps indicates that the probable movement of Morrison Formation water is west-northwest from the well at T21N, R9W, toward the well field and the Apache Foshay test well. The chemical differences between these two wells

appear to verify this hypothesis, as Apache Foshay water shows higher sodium and chloride concentrations and lower calcium and sulfate concentrations than the well at T21N, R9W. These changes could result from ion-exchange and precipitation reactions occurring along this flow path.

Very few water quality data are available for the Entrada Sandstone near the well-field site. It is generally observed that its water quality deteriorates toward the center of the basin as TDS concentrations of 1000 mg/l or less occur in or near recharge areas south of Crownpoint and in the Chuska Mountains, and TDS concentrations over 10,000 mg/l have been observed in the center of the basin. The best water quality data for the Entrada Sandstone near the well field site were also taken from the Apache Foshay test well. The results of that test are shown in Table 4-3. This water, too, could be classified as a sodium sulfate water, with large additional concentrations of chloride.

This extremely hard water would require additional treatment before it could be used for beneficial purposes such as irrigation or stock watering. Particular problems for agricultural use are the high TDS levels, specifically the sodium and TDS levels (problems are typically caused when TDS levels exceed 2000 mg/l and sodium adsorption ratio is greater than 18. The high TDS would also limit stock watering, as a maximum TDS content of 3000 mg/l is recommended for this use. As shown in Table 3-2, the sulfate, chloride, and TDS concentrations grossly exceed the recommended limits for these constituents in drinking water. As for water from the Morrison Formation, use of water from the Entrada Formation in steam generation facilities would require extensive treatment.

Water quality in the overlying Dakota Sandstone is poorer than that found in the Westwater Canyon Member, but the spatial quality variations follow similar trends in that TDS concentrations increase with distance from the southern outcrop of the formation. A chemical analysis of water from a well penetrating the Dakota Sandstone is shown in Table 4-4. This water could be characterized as a sodium bicarbonate water, with lesser quantities of sulfate and chloride. Without further treatment, then, water withdrawn from this part of the Dakota Sandstone would not meet minimum criteria and standards for drinking water,

Table 4-3. CHEMICAL ANALYSES FOR ENTRADA SANDSTONE WATER FROM APACHE FOSHAY TEST WELL

Water Quality Parameters[a]	Concentration
General Constituents	
Water Temperature, °C	58
pH, pH Units	7.55
Specific Conductance, μmhos/cm	20,000
TDS (calculated)	15,021
Suspended Solids	32
Alkalinity	—
Hardness, total as $CaCO_3$	1500
Hardness, non-carbonate	1356
Carbon Dioxide, calculated	7
Hydrogen Sulfide	0
Sodium Adsorption Ration (SAR)	51.8
Common Ions	
Calcium	520
Magnesium	49
Sodium	3600
Potassium	27
Iron, total	2.4
Iron, dissolved	0.60
Manganese, as Mn	0.26
Bicarbonate	176
Sulfate	6039
Chloride	3622
Carbonate	0
Fluoride	3
Silica, as SiO_2	18.4
Boron	2
Nutrients	
Nitrate	0.63
Total Phosphate as PO_4	0.31

Source: Shomaker 1974.

[a]All units mg/l unless otherwise noted.

Table 4-4. CHEMICAL ANALYSES FOR WATER FROM DAKOTA SANDSTONE WELL

Water Quality Parameters[a]	Concentration
General Constituents	
Water Temperature	—
pH, S.U.	8.3
Specific Conductance	—
TDS	6004
Alkalinity	—
Hardness	—
Common Ions	
Calcium	27
Magnesium	7
Sodium	1820
Potassium	—
Iron	—
Bicarbonate	2025
Carbonate	48
Sulfate	1669
Chloride	408
Fluoride	—
Nitrate	—
Silica, as SiO_2	—
Boron	—

Source: Geohydrology Associates 1980.

Location: T24N R9W 1.3
Date: 10/06/52
Name: Magnolia Well

[a]All units mg/l unless otherwise indicated.

stock watering, or irrigation. It is expected that the future water quality of these aquifers would be very similar to that described above. Again, use of water from the Dakota Sandstone in steam generation facilities would require extensive treatment.

4.2 WATER QUALITY IMPACTS

4.2.1 Construction

Degradation of both surface- and ground-water (i.e. in alluvial and surficial water-bearing zones) quality could result from spills of various liquids used or consumed during construction. Should such spills occur, the quantity of material lost is expected to be small and only an extremely localized area would be affected. (See Suggested Mitigation section.)

Another construction activity that may have an impact on both surface and ground-water (i.e., in alluvial and other surficial water-bearing zones) quality is the discharge of hydrostatic test waters. At present no specific plans have been made for this discharge, other than but it is being designed to meet state and federal standards. The EPA Region VI office in Dallas, Texas, regulates the discharge of hydrostatic test waters to surface waters and requires that an application for a discharge permit be sent to its office 180 days in advance of the discharge. Unless there are unusual aspects of the discharge or testing activities, the permit is immediately granted. The major problems with such discharges occur when an older line is rehabilitated and tested, allowing the discharge of contaminants attached to the pipe walls. With new pipe, water-quality changes in the test water are usually minimal.

As mentioned in Section 5.2.4, state of New Mexico regulations limit the discharge of pollutants into ground-water systems. Although a number of specific exemptions to these regulations are in effect, the discharge of hydrostatic testing fluids would require state approval. The applicant is required to state the expected quality and location of the discharge and the expected water quality and geologic characteristics of the areas to receive the discharge.

Groundwater from the Morrison Formation is likely to be used for hydrostatic testing of the well field pipeline. The quality of this water has been previously characterized in Table 4-2. The quality of water in alluvial water-bearing zones has also been characterized in Table 5-4. It is apparent from a comparison between these tables that alluvial water quality varies tremendously and that Morrison Formation waters could improve or degrade alluvial groundwaters depending on the location of discharge. As noted in the Suggested Mitigation section, procedures are available to reduce potential water quality impacts from the disposal of hydrostatic test waters.

As noted in Section 5.2, New Mexico has ground-water quality regulations which limit the degradation of existing groundwaters to existing standards or the prevailing ground-water quality if the TDS of existing groundwater is less than 10,000 mg/1. Consequently, the discharge of Westwater Canyon Member waters into alluvial water-bearing zones could violate New Mexico water quality regulations in cases where alluvial waters receiving discharges have better quality than Morrison Formation waters.

The New Mexico State Engineer has regulations governing the drilling into artesian aquifers. These regulations outline procedures designed to limit potential cross contamination between aquifers during drilling operations and later during operational pumping. As drilling operations at the well field must comply with these regulations, cross-contamination problems would be controlled. A specific plan for the disposal of drilling muds has not been presented. As noted in the Suggested Mitigation section, procedures are available for limiting the potential water quality effects of drilling mud storage and disposal.

4.2.2 Operation

As mentioned in the Hydrology Technical Report, operation of the well field would cause large drawdowns in the potentiometric surface of the Westwater Canyon Member of the Morrison Formation. The largest drawdowns would occur in the immediate vicinity of the well field. Most of the withdrawn water would be derived from the release of compressed water from the Westwater

Canyon aquifer in the immediate vicinity of the well field. Consequently, it is expected that even though the water quality in the Westwater Canyon Member varies considerably over the entire San Juan Basin, the water quality from this field would remain relatively constant in quality throughout the proposed project.

The other potential way in which the quality of withdrawn water could change is the leakage of poorer quality water from adjacent aquifers (i.e., the Entrada and Dakota sandstones) into the Westwater Canyon Member of the Morrison Formation. The results of the groundwater modeling performed for the Hydrology Technical Report indicate that the leakage expected from these aquifers is quite small, even when the drawdown of the potentiometric surface in the Westwater Canyon Member is greatest (i.e., at the end of well-field operation). The potential increase in the TDS concentration of the Westwater Canyon Member can be estimated using a mass-balance equation considering the volumetric contributions and water qualities expected to be withdrawn from each aquifer. According to these calculations, the maximum percentage increase in the TDS concentration of Westwater Canyon Member water would be about 5 percent. This increase should have little effect on the subsequent water treatment provided by PNM.

It was also noted in the Hydrology Technical Report that there would be slight decreases (i.e. less than 1 percent) in flow for several area streams (San Juan River and the Rio San Jose). As this maximum decrease is very small, the downstream salinity increase (due to the salt-concentrating effect) would be negligible.

5.1 SURFACE-WATER QUALITY

As mentioned previously, a number of ephemeral channels drain the area of the plant site. A limited number of water quality measurements are available for monitoring stations on selected channels. Because of the intermittent nature of stream flow, there are relatively large variations in water quality. Water quality variations have been summarized (BLM 1976) and are discussed below.

"Water quality of the first arroyo flows of the spring or early summer is usually poor because of fall and winter accumulations of soluble materials originating from weathered soils and rocks, from evaporation of saline water, and from animal and plant wastes. After the initial flushing, the quality of the water improves progressively through the storm season unless extended intermediate dry periods allow soluble materials to accumulate on the watershed. During a storm event, the greatest concentrations of suspended and dissolved material are carried during the rising stage. The water quality usually improves thereafter until the final trickles, containing higher dissolved concentrations from bank storage, seep back into the channel..."

A summary of available surface-water quality data obtained from the U.S. EPA's STORET computerized surface-water quality data base is listed in Table 5-1. As shown in Figure 5-1, the stations are generally arranged in the table according to their upstream position in the watershed.

As Table 5-1 shows, the time-averaged water quality of De-na-zin Wash and its tributaries can be characterized by moderate conductivity levels, slightly alkaline pH, extremely high levels of suspended solids, and high levels of total organic carbon. The relatively high levels of total organic carbon are undoubtedly due to the very high suspended-solids content of these waters. Nitrogen and phosphorus levels are relatively high compared with levels in the San Juan River.

Table 5-1. SURFACE WATER QUALITY NEAR THE NMGS PLANT SITE

Water Quality Parameters[a]	Chaco River at Hwy. 371 Brdg. 36°06'50" 108°11'28"	De-Na-Zin Wash Above Tanner Lake 36°14'45" 108°7'15"	De-Na-Zin Tributary 36°15'28" 108°8'46"	De-Na-Zin Tributary 36°14'39" 108°8'42"	De-Na-Zin Tributary 36°14'21" 108° 09'58"
General Constituents[b]					
Flow, cfs	———	480(400-500) 5[b]	———	———	.01(1)
Date	4/22/81	8/1/76 - 8/19/77	8/20/76 - 11/3/78	9/27/76 - 11/3/78	4/9/75
pH, S.U.	8.9(8.9) 1	7.3(7.2-7.5) 4	7.1(6.8 - 7.3) 6	7.6(7-8.4) 10	8.3(1)
Specific Conductance, mhos/cm	3250(1)	994(550-1200) 4	842(520-1750) 6	670(390-1750) 10	862(1)
Total Dissolved Solids	———	---------	---------	———	569(1)
Suspended Solids	———	187,606(76,800-316,000) 4	79,400(38,000-144,000) 7	47,300(27,100-108,000)	———
Turbidity, JTU	———	———	———	———	———
Alkalinity, as $CaCO_3$	465(1)	———	244(218-269) 2	228(217-243) 3	243(1)
Hardness, as $CaCO_3$	92(1)	———	———	———	43(1)
Dissolved Oxygen	———	———	———	———	———
Total Organic Carbon	———	300(206-386) 3	305(165-471) 5	187(102-328) 6	———
Total N	———	———	———	———	———
Total P	———	———	———	———	———
Common Ions					
Calcium	27(1)	———	———	———	15(1)
Magnesium	6(1)	———	———	———	1.3(1)
Sodium	730(1)	———	———	———	170(1)
Potassium	6.4(1)	———	———	———	7.1(1)
Bicarbonate	510(1)	———	297(266-328) 2	———	296(1)
Sulfate	1000(1)	———	———	———	170(1)
Chloride	160(1)	———	———	———	15(1)
Silica	3.3(1)	———	———	———	7.8(1)
Fluoride	2.5	———	———	———	0.9(1)
Boron, dissolved[c]	0.30	.26 (total)	.23(.19-.28) 5	.18(.14-.22) 7	.040(1)
Iron, dissolved[c]	0.55	11000(1)	320(310-330) 2 (total)	208(180-250) 4	0.1(1)
Trace Elements, µg/l[c]					
Arsenic	———	580(90-1300) 3	246(48-980) 6	105(25-550) 9/2(1)	38(1)
Barium	———	2.5	3800(3600-4000) 2	2100(1600-2400) 4	———
Cadmium	———	40(1)	———	———	———
Chromium	———	380(1)	———	———	———
Copper	———	———	———	———	———
Lead	———	1500(1)	800(1)	450(400-500) 2	———
Mercury	———	3.5(1.4-5.5)	2.2(.9-3.8) 4	1.6(.4-3.2) 4	———
Nickel	———	———	———	———	———
Selenium	———	(0) 1	2(0-6) 4	2(0-6) 4/2(1)	4(1)
Zinc	———	———	———	———	———

Source: EPA STORET retrieval, 1981.

[a] All units in mg/l and are total values unless otherwise indicated.

[b] For those table listings for which two numbers are given, the first value is the mean value and the value in parentheses is the number of samples; for those listings for which three values are given, the first value is the mean value, the numbers in parentheses represent the range of values and the next number is the number of samples.

[c] Total/dissolved.

Table 5-1. SURFACE WATER QUALITY NEAR THE NMGS PLANT SITE (continued)

Water Quality Parameters[a]	Coal Creek at Tanner Lake 36°14'7" 108°7'47"	Alamo Wash near Tanner Lake 36°14'7" 108°10'52"	De-Na-Zin Wash 36°13'51" 108°11'57"	Chaco River below De-Na-Zin Wash 36°11'37" 108°20'21"
General Constituents[b]				
Flow, cfs	140(0-1000) 9	478(0-1000) 20	163(0-925) 89	406(25-1000) 10
Date	8/21/75 - 9/17/80	10/31/74 - 9/17/80	8/12/74 - 3/11/81	8/4/76 - 3/15/79
pH, S.U.	7.3(6.9-8.1) 6	7.5(7.2-8) 9	7.9(6.5-9) 36	7.3(7-7.7) 9
Specific Conductance, mhos/cm	587(435-825) 7	1050(480-1500) 12	720(220-1500) 43	1010(575-1300) 3
Total Dissolved Solids	408(330-486) 2	———	432(273-555) 9	———
Suspended Solids	45,500(6980-120,000) 6	127,000(47-626,000) 14	54,300(0-197,000) 86	23,100
Turbidity, JTU	———	———	6500(1)	———
Alkalinity, as $CaCO_3$	182(160-203) 2	237(143-330) 2	197(102-303) 14	380(1)
Hardness, as $CaCO_3$	49(24-74) 2	———	27(9-73) 12	———
Dissolved Oxygen	———	———	9.2(1)	———
Total Organic Carbon	302(17-472) 4	392(307-456) 3	114(6.4-431)	371(210-556) 5
Total N			17.4(5.5-34) 5	29(1)
Total P			1.7(.12-4.6) 8	7.3(1)
Common Ions				
Calcium	17(9-26) 2	———	9.8(3-28) 12	59(1)
Magnesium	1.4(.5-2.3) 2	———	.7(.2-1.4) 12	———
Sodium	125(110-140) 2	———	142(95-200) 12	280(1)
Potassium	4.3(3.2-5.4) 2	———	2.8(1.4-5.2) 13	4.1(1)
Bicarbonate	224(200-248) 2	287(174-400) 2	241(124-360) 10	460(1)
Sulfate	120(79-160)	———	146(100-200) 11	390(1)
Chloride	6.6(4.5-8.6) 2	———	7.4(3.1-12) 11	8.2(1)
Silica	10.6(8.3-13) 2	———	15(1.7-31) 11	15(1)
Fluoride	1(.8-1.2) 2	———	1.2(0.7-31) 11	.9(1)
Boron, dissolved[c]	.29(.2-.39) 3 (total)	.24(.14-.41) 6	.18(.12-.28) 11/.12(.03-.28) 14	.230(.210-.250) 2/.090(1)
Iron, dissolved[c]	265(110-420) 2/.09(.03-.15) 2	452(200-850) 6	196(8)/.37(.02-1.4) 16	550(1)/.06(1)
Trace Elements, µg/l[c]				
Arsenic	480(160-850) 3	340(35-1200) 6/80(1)	85.3(0-640) 17/5.1(1-20) 8	250(61-440) 2/2(1)
Barium	5400(300-5400) 3	5300(1700-17,000) 6	3300(100-10,000) 11/63(0-200) 8	4550(3100-6000) 1
Cadmium	17(10-20) 3	30(1)	28.3(1-70) 10/.8(0-2) 6	40(1)
Chromium	550(50-1400) 3	1170(240-2100) 2	230(50-900) 7/3.3(0-10) 6	280(2)/3(1)
Copper	85(10-160) 2	———	692(340-1600) 6/18(8-32) 3	1500(1)
Lead	570(200-800) 3	1200(400-2500) 6	534(100-1200) 11/5(0-23) 10	1250(1200-1300) 2/5(1)
Mercury	3.1(1.7-4.9) 3	2.8(2.4-3.2) 2	1.9(0-5.9) 15/.04(0-.2) 5	3(2.4-3.2) 3
Nickel	———	———	———	
Selenium	2(0-4) 3	11(0-32) 3	4.5(0-18) 13/2.8(4-15) 5	0(1)
Zinc	———	740(1)/10(1)	———	

Table 5-1. SURFACE WATER QUALITY NEAR THE NMGS PLANT SITE (concluded)

Water Quality Parameters[a]	Hunter Wash Tributary 36°15'33" 108°15'6"	Hunter Wash at Bisti 36°16'37" 108°15'12"	Chaco River at Burnham 36°21'57" 108°33'57"
General Constituents[b]			
Flow, cfs	203(0-500) 19	55(0-610) 154	1093(0-7450) 47
Date	7/13/76 - 9/17/80	9/11/74 - 3/11/81	7/20/77 - 7/2/81
pH, S.U.	7.3(6.6 - 7.9)	7.7(6.9 - 9.8) 61	8.1 (6.7 - 8.9) 36
Specific Conductance, mhos/cm	1010(580-2200) 11	1066(435-5010) 73	1180(300-8400) 36
Total Dissolved Solids	480(1)	637(309-1230) 21	452(233-720) 13
Suspended Solids	85,510(310-278,000) 12	46,800(0-273,000) 158	58,930(2470-236,000) 39
Turbidity, JTU	———	4290(310-12,000) 3	———
Alkalinity, as $CaCO_3$	273(253-292) 2	159(0-275) 31	253(75-530) 18
Hardness, as $CaCO_3$	140(1)	69(15-300) 22	48(18-80) 16
Dissolved Oxygen	———	10.2(1)	8.5(6.4-11.2) 19
Total Organic Carbon	1025(70-1980) 2	184(4-504) 21/8.9(8.1-10) 3	293(29-792) 14/10(5-15) 18
Total N	———	18(16-20) 2	17.8(.4-59) 16/5.6(2)
Total P	———	1.7(.17-2.8) 3	3(.9-7.1) 18/.1(.04-.48) 17
Common Ions			
Calcium	49(1)	23.5(4.7-100) 22	16.5(6.5-27) 16
Magnesium	4(1)	2.4(.4-12) 22	1.6(.5-3.1) 16
Sodium	120(1)	184(91-340) 22	129(34-250) 16
Potassium	6.3(1)	5(2.6-13) 22	3.2(1.9-5.6) 17
Bicarbonate	332(308-356) 2	192(0-335) 31	294(92-600) 17
Sulfate	110(1)	275(52-710) 22	144(74-300) 17
Chloride	(3.3)	11.2(1-21) 21	8.2(2.5-13) 16
Silica	14(1)	19.5(12-60) 22	12.3(5.5-23) 17
Fluoride	.04(1)	1(.3-2.2) 22	.8(.2-1.2) 17
Boron, dissolved[c]	.175(.17-.18) 2/80(1)	.22(.12-.57) 25/.216(30)	.23(.13-.32) 3/.1(.03-.290) 18
Iron, dissolved[c]	245(200-290) 2/.03(1)	294(22-750) 26/1.3(.01-16) 23	225(2)/.46(.01-2.2) 17
Trace Elements, $\mu g/l$[c]			
Arsenic	345(0-2500) 9	92(0-950) 28/1.9(1-3) 7	127(4-940) 19/3.4(1-6) 7
Barium	1700(1600-1800) 2		4900(600-8600) 7/100(0-300) 7
Cadmium	10(1)	10(0-40) 12/.7(0-1) 3	8.9(0-30) 7/.8(0-2) 6
Chromium	120(1)	255(50-1700) 12/10(0-40) 4	149(30-280) 7/2.9(0-10) 7
Copper	380(1)	655(170-1400) 11/14(7-20) 3	519(33-1000) 6/17(0-30) 6
Lead	600(500-700) 2	571(37-1600) 22/6(0-28) 7	544(56-1200) 8/9.8(0-44) 8
Mercury	2.2(.08-5.1) 8	1.7(.2-5) 19/.05(0-.2) 4	2.3(.3-6.2) 16/.05(0-.1) 6
Nickel	———	74(1)/2(1)	106(31-220) 5/2.7(0-4) 6
Selenium	.38(0-1) 8	2.7(0-15) 16/5.7(4-8) 3	5.8(0-21) 17/3.3(0-7) 6
Zinc	———	1200(1000-1400) 4/27(10-50) 3	916(130-1800) 5/22(4-70) 6

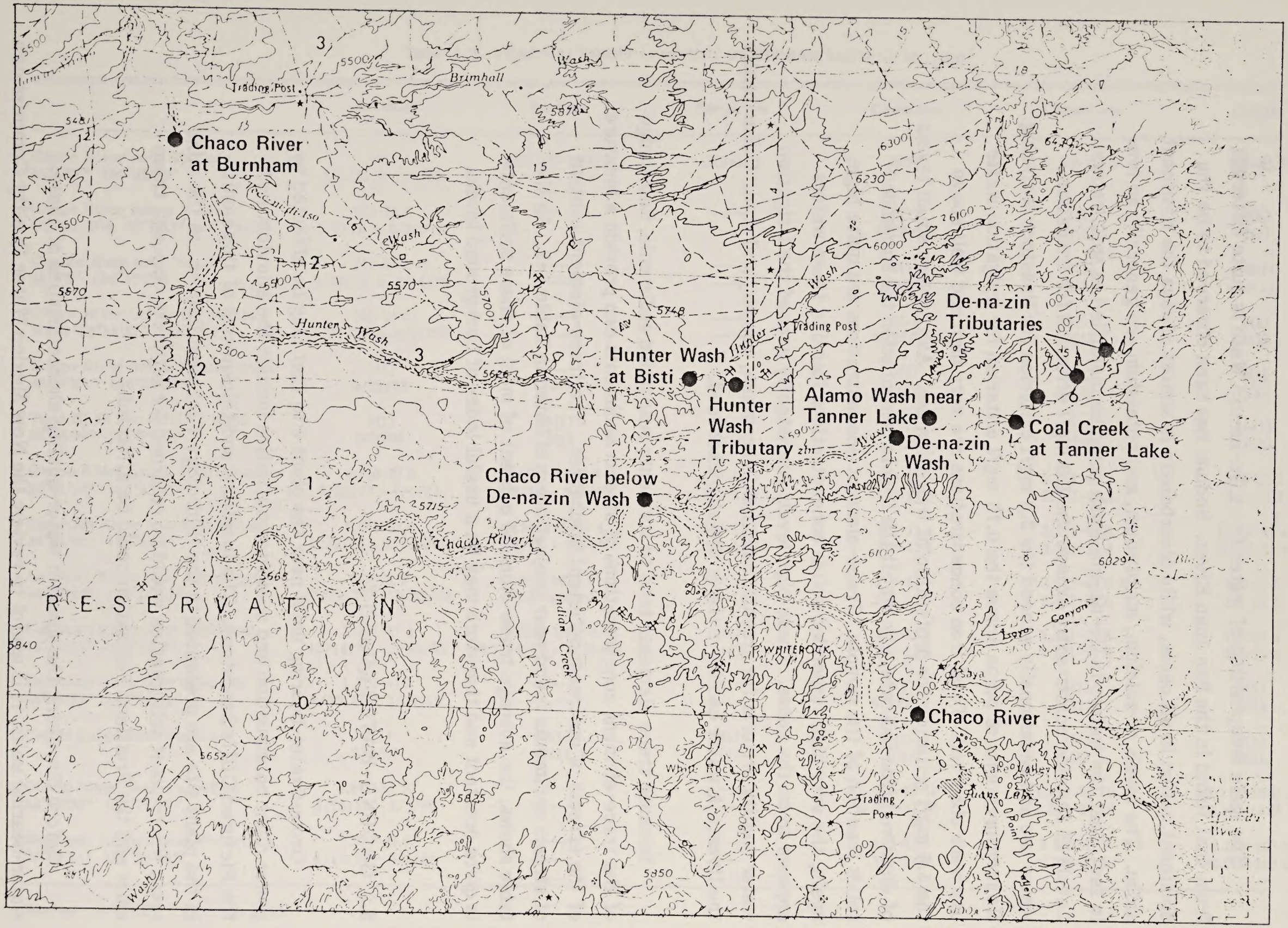


Figure 5-1. LOCATIONS OF STATIONS NEAR THE PLANT SITE FROM WHICH WATER QUALITY DATA HAVE BEEN COLLECTED

The ionic composition of water from De-na-zin Wash is quite different from that found in the San Juan River. Sodium has been observed to be the dominant cation in all cases, while bicarbonate is almost always the dominant anion. The levels of calcium, magnesium, and potassium are generally so low, in fact, that the waters in De-na-zin Wash could be classified as soft waters. Levels of fluoride consistently exceed the 1.0 mg/l criterion for irrigation water use and occasionally exceed the 2.0 mg/l criterion for livestock watering. No measurements of boron above the 0.75 mg/l criterion for irrigation water use were observed. Total iron concentrations are very high and well above the 5.0 mg/l criterion for protection of irrigation use. As the very small levels of dissolved iron indicate, almost all the iron is contained in the suspended-solids fraction of the sample. Trace-element concentrations are quite high; again, the very high suspended-solids concentrations found in these waters appears to be the cause. These high levels consistently exceed the irrigation water quality criteria for arsenic, cadmium, chromium, copper, and zinc. Occasionally the livestock water quality criteria are also exceeded.

Because trace elements tend to sorb onto suspended sediments, knowledge of the trace-element concentrations of stream sediments can provide a measure of the effects of upstream pollutant discharges. The trace-element content of stream sediments found near project areas is listed in Table 5-2. As the table shows, the average trace-element content of most of these sediments is quite constant and therefore may be a useful index of background levels.

5.2 GROUND-WATER QUALITY

Groundwater-bearing units near the plant site that may be affected by power plant construction and operation activities include the alluvium and the Pictured Cliffs Sandstone. The locations and thicknesses of these units in the plant site are presented in the Hydrology Technical Report. In the mine area, where plant solid wastes would be returned for ultimate disposal, these units and the Fruitland Formation could be affected.

Before discussing the specific water-quality characteristics of these water-bearing units, it is useful to review the New Mexico Water Quality Commission's

Table 5-2. TRACE ELEMENT CONTENT OF STREAM SEDIMENTS (ppm)

	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt
Chaco River near Starlake 35°56'7" 107°31'39"	3(2) 5/8/78 & 8/6/80	105(100-110) 2	.5(0-1) 2	0(2)	1.5(0-2) 2	2(0-4) 2
Chaco River below E. Wash, Chaco, NM 36°4'53" 108°1'20"	1(0-2) 2 5/7/78 & 9/26/78	———	———	0(1) 9/26/78	0(1) 0(1)	3(1) 3(1)
Coyote Wash near Naschiti 36°8'9" 108°32'34"	3(1-5) 2 9/28/78 & 2/14/79	———	———	0(1) 9/28/78	4(1) 4(1)	10(1) 10(1)
Chaco River below De-na-zin Wash 36°11'37" 108°20'21"	1(0-2) 2 9/27/78 & 3/15/79	———	———	0(1) 9/27/78	3(1) 3(1)	1(1) 1(1)
Chaco River below Hunter Wash 36°17'51" 108°32'52"	1(1) 9/28/78	———	———	0(1) 0(1)	2(1) 2(1)	4(1) 4(1)
Teec Ni Di Tso (TNDT) Wash 36°18'26" 108°27'22"	4(1) 9/9/80	75(1) 75(1)	0(1) 0(1)	1(1) 1(1)	2(1) 2(1)	10(1) 10(1)
Chaco River below TNDT Wash 36°21'57" 108°33'57"	1.3(0-2) 3 7/20/77 - 6/2/81	84(70-110) 3 5/8/78 - 5/7/80	.3(0-1) 3 .3(0-1) 3	.3(0-1) 3 .3(0-1) 3	2.3(1-4) 3 2.3(1-4) 3	.7(0-2) 3 .7(0-2) 3
San Juan River near Bloomfield 36°41'22" 108°5'42"	1.8(1-3) 4 12/9/77 - 11/24/80	115(30-230) 4 12/9/77 - 7/24/79	.3(0-1) 4 .3(0-1) 4	.3(0-1) 4 .3(0-1) 4	3.5(1-5) 4 3.5(1-5) 4	2.5(0-5) 4 2.5(0-5) 4
La Plata River near Farmington 36°44'23" 108°14'51"	2(0-3) 5 12/12/77 - 10/29/79	60(0-100) 5 60(0-100) 5	.2(0-1) 5 .2(0-1) 5	.2(0-1) 5 .2(0-1) 5	2.2(1-4) 5 2.2(1-4) 5	1(0-5) 5 1(0-5) 5
San Juan River near Fruitland 36°44'25" 108°24'9"	1.8(0-4) 4 12/14/77 - 5/28/81	78(32-120) 4 12/14/77 - 4/25/79	0(4) 0(4)	.3(0-1) 4 .3(0-1) 4	1.5(1-2) 4 1.5(1-2) 4	2(0-5) 4 2(0-5) 4
Sanostee Wash near Sanostee TP 36°28'13" 108°34'41"	1.7(0-4) 3 6/23/78 - 3/15/79	———	———	0(1) 9/29/78	2(1) 2(1)	0(1) 0(1)
Canon Largo near Blanco	2(1) 5/2/78	30(1) 30(1)	1(1) 1(1)	0(1) 0(1)	1(1) 1(1)	0(1) 0(1)
Chaco River near Waterflow 38°43'28" 108°35'27"	4.4(1-8) 10 5/25/78 - 8/5/80	———	———	0.2(0-2) 10 0.2(0-2) 10	1.5(0-2) 10 1.5(0-2) 10	12.1(0-100) 10 12.1(0-100) 10
Shumway Arroyo near Waterflow 36°46'24" 108°26'26"	5.2(2-8) 9 8/17/78 - 9/2/80	———	———	.1(0-1) 9 .1(0-1) 9	3.2(0-8) 9 3.2(0-8) 9	2.2(0-10) 2 2.2(0-10) 2

Source: STORET Retrieval, 1981.

Table 5-2. TRACE ELEMENT CONTENT OF STREAM SEDIMENTS (ppm) (continued)

	Copper	Lead	Manganese	Molybdenum	Nickel	Selenium
Chaeo River near Starlake 35°56'7" 107°31'39"	5.5(5-6) 2	0(2)	1800(1600-2000) 2	.5(0-1) 2	10(2)	0(2)
Chaeo River below E. Wash, Chaeo, NM 36°4'53" 108°1'20"	0(1) 0(1)	4(1) 4(1)	160(1) 8/1/76	0(1) 8/1/76	---- ----	0(1) 9/26/78
Coyote Wash near Nasehiti 36°8'9" 108°32'34"	11(1) 11(1)	12(1) 12(1)	200(1) 200(1)	0(1) 2/14/79	---- ----	0(1) 0(1)
Chaeo River below De-na-zin Wash 36°11'37" 108°20'21"	2(1) 2(1)	1250(1200-1300) 2 8/4/76 & 7/21/77	130(1) 9/27/78	0(1) 3/15/79	---- ----	0(1) ----
Chaeo River below Hunter Wash 36°17'51" 108°32'52"	1(1) 1(1)	6(1) 6(1)	100(1) 100(1)	---- ----	---- ----	---- ----
Teee Ni Di Tso (TNDT) Wash 36°18'26" 108°27'22"	1(1) 1(1)	10(1) 10(1)	460(1) 460(1)	0(1) 0(1)	10(1) 10(1)	0(1) 0(1)
Chaeo River below TNDT Wash 36°21'57" 108°33'57"	2.7(1-4) 3 2.7(1-4) 3	0(3) 0(3)	97(0-160) 3 97(0-160) 3	.3(0-1) 3 .3(0-1) 3	4.7(0-10)3 4.7(0-10)3	0(3) 0(3)
San Juan River near Bloomfield 36°41'22" 108°5'42"	1.8(0-5) 4 1.8(0-5) 4	4.5(0-10) 4 4.5(0-10) 4	120(100-140) 4 120(100-140) 4	1.8(0-4) 4 1.8(0-4) 4	2.5(0-5)4 2.5(0-5)4	0(4) 0(4)
La Plata River near Farmington 36°44'23" 108°14'51"	1.4(0-5) 5 1.4(0-5) 5	3.2(0-10) 5 3.2(0-10) 5	136(0-220) 5 136(0-220) 5	1.4(0-4) 5 1.4(0-4) 5	2(0-10)5 2(0-10)5	.2(0-1)5 .2(0-1)5
San Juan River near Fruitland 36°44'25" 108°24'9"	3.5(0-9) 4 3.5(0-9) 4	7.5(0-20) 4 7.5(0-20) 4	155(30-240) 4 155(30-240) 4	2.5(0-4) 4 2.5(0-4) 4	2(0-5)4 2(0-5)4	0(4) 0(4)
Sanostee Wash near Sanostee TP 36°28'13" 108°34'41"	3(1) 3(1)	10(1) 10(1)	73(1) 73(1)	1.5(0-3) 2 6/23/78 & 3/15/79	---- ----	0(2) 0(2)
Canon Largo near Blaneo	0(1) 0(1)	0(1) 0(1)	93(1) 93(1)	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)
Chaeo River near Waterflow 38°43'28" 108°35'27"	24.3(1-150) 10 24.3(1-150) 10	66(0-500) 10 66(0-500) 10	233(110-330) 10 233(110-330) 10	---- ----	---- ----	.1(0-1)10 .1(0-1)10
Shumway Arroyo near Waterflow 36°46'24" 108°26'26"	76(4-600) 9 76(4-600) 9	130(0-1000) 9 130(0-1000) 9	128(30-210) 9 128(30-210) 9	---- ----	---- ----	.7(0-2)9 .7(0-2)9

Source: STORET Retrieval, 1981.

Table 5-2. TRACE ELEMENT CONTENT OF STREAM SEDIMENTS (ppm) (concluded)

	Zinc	Mercury
Chaco River near Starlake 35°56'7" 107°31'39"	11(10-12) 2	.015(.01-.02) 2
Chaco River below E. Wash, Chaco, NM 36°4'53" 108°1'20"	3(1) 3(1)	0(1) 0(1)
Coyote Wash near Naschiti 36°8'9" 108°32'34"	19(1) 9/28/78	.03(1) .03(1)
Chaco River below De-na-zin Wash 36°11'37" 108°20'21"	4(1) 9/27/78	0(1) 0(1)
Chaco River below Hunter Wash 36°17'51" 108°32'52"	4(1) 4(1)	0(1) 0(1)
Teec Ni Di Tso (TNDT) Wash 36°18'26" 108°27'22"	5(1) 5(1)	.01(1) .01(1)
Chaco River below TNDT Wash 36°21'57" 108°33'57"	9.4(9-10) 3 9.4(9-10) 3	.013(.01-.02) 3 .013(.01-.02) 3
San Juan River near Bloomfield 36°41'22" 108°5'42"	6.3(3-13) 4 6.3(3-13) 4	.008(0-.02) 4 .008(0-.02) 4
La Plata River near Farmington 36°44'23" 108°14'51"	4.4(0-6) 5 4.4(0-6) 5	.008(0-.01) 5 .008(0-.01) 5
San Juan River near Fruitland 36°44'25" 108°24'9"	37(27-60) 4 37(27-60) 4	.005(0-.01) 4 .005(0-.01) 4
Sanostee Wash near Sanostee TP 36°28'13" 108°34'41"	10(1) 9/29/78	.01(1) .01(1)
Canon Largo near Blanco	4.5(1) 4.5(1)	0(1) 0(1)
Chaco River near Waterflow 38°43'28" 108°35'27"	8.2(3-15) 10 8.2(3-15) 10	.005(0-.01) 10 .005(0-.01) 10
Shumway Arroyo near Waterflow 36°46'24" 108°26'26"	24(10-43) 9 24(10-43) 9	.04(0-.1) 9 .04(0-.1) 9

Source: STORET Retrieval, 1981.

ground-water quality regulations. These regulations, designed to protect the present and potential future use of ground-water for domestic and agricultural water supplies, stipulate that only ground water with an existing TDS concentration of 10,000 mg/l or less is to be protected. These regulations permit degradation of the ground water up to the limit of the standard if the existing concentration of any contaminant in that ground water conforms to the appropriate standard. No degradation of the ground water beyond the existing concentration is allowed if the existing concentration of any water contaminant in the ground water exceeds the appropriate standard. New Mexico ground-water quality standards are listed in Table 5-3.

The ground-water quality of alluvium near the plant site was assessed through a water-quality sampling program designed by Shomaker (1980) and operated by PNM. The system consists of seven alluvial wells and two wells tapping the underlying Pictured Cliffs Sandstone; the locations of these wells are shown in Map 5-1. The average and range of water qualities observed in the alluvial wells (A-2 through A-7) near the plant site are listed in Table 5-4.

As Table 5-4 shows, TDS concentrations range from less than 1500 mg/l to almost 60,000 mg/l. TDS variations within the same well are smaller but can range over a factor of 2. It is postulated by Shomaker (1980) that the wide range in water qualities is directly related to the wide range in horizontal permeabilities. Limited pumping tests showed that higher-quality waters were associated with more permeable strata and lower-quality waters with the least permeable alluvium. The predominant cation in all waters was sodium, while sulfate was the predominant anion in the high-TDS waters. Sulfate and bicarbonate were the dominant anions in low-TDS groundwater.

As mentioned previously, ground water with TDS concentrations of less than 10,000 mg/l is to be protected according to NMWQC regulations. Only two of the wells (A-2, A-4) listed in Table 4-4 had TDS concentrations greater than the 10,000 mg/l maximum. For the other wells, the measured values of the water quality constituents can be compared with state standards and with the water quality criteria for stock watering and irrigation uses listed in Table 3-3. Such comparisons yield the following results (PNM 1981).

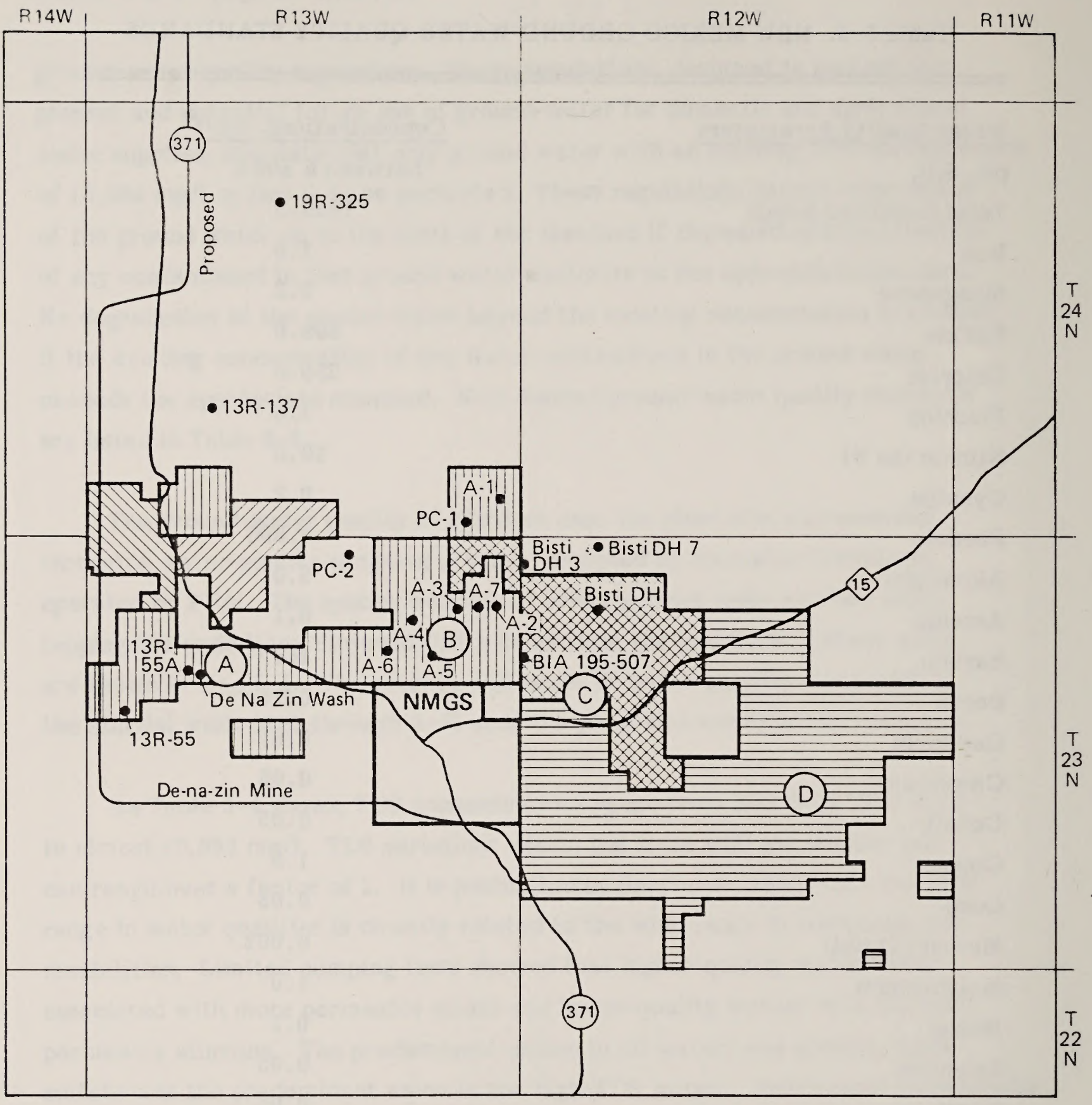
Table 5-3. NEW MEXICO GROUND-WATER QUALITY STANDARDS

Water Quality Parameters	Concentrations, mg/l[a]
pH, S.U.	between 6 and 9
Total Dissolved Solids	1000.0
Iron	1.0
Manganese	0.2
Sulfate	600.0
Chloride	250.0
Fluoride	1.6
Nitrate (as N)	10.0
Cyanide	0.2
Phenols	0.005
Aluminum	5.0
Arsenic	0.1
Barium	1.0
Boron	0.75
Cadmium	0.01
Chromium	0.05
Cobalt	0.05
Copper	1.0
Lead	0.05
Mercury (total)	0.002
Molybdenum	1.0
Nickel	0.2
Selenium	0.05
Silver	0.05
Zinc	10.0
Uranium	5.0
Radioactivity[b]	30.0

Source: New Mexico Water Quality Control Commission Regulations.

[a]Units are mg/l unless otherwise indicated. These standards apply to the dissolved portion of the contaminants specified with the definition of dissolved being that given in the publication "Methods for Chemical Analysis of Water and Waste of the U.S. Environmental Protection Agency" with the exception of mercury, which shall be total.

[b]Combined ^{226}Ra and ^{228}Ra, in pCi/l.



LEGEND

- Bisti Mine Leases
- Bisti Mine PRLA
- Leases Subject to Trade
- Potential Lease Exchange Area
- Additional Potential Trade Leases

N

0 1 2

miles

Source: NMGS Project Description (PNM, 1981).

Map 5-1. LOCATION OF PNM AND OTHER WELLS AT WHICH WATER QUALITY DATA ARE AVAILABLE

Table 5-4. WATER QUALITY IN THE PNM ALLUVIAL WELLS NEAR THE PLANT SITE

Location	T.23N. R.13W., 12		T.23N., R.13W., 12		T.23N., R.13W., 14	
Name	PNM A-2		PNM A-3		PNM A-4	
Dates	6/27/79-12/17/80		6/28/79-12/18/80		6/28/79-12/18/80	
Water Quality Parameter[a]	Avg.	Range	Avg.	Range	Avg.	Range
Temperature (°C)	13.9	11-15.5	12.7	10-14	13.5	12-15
pH (S.U.)	7.4	6.6-8.2	7.7	7.4-8.3	7.4	7.3-7.7
Specific Conductance[b]	22,400	20,400-24,200	1562	1400-1800	25,540	23,900-27,200
Total Dissolved Solids	48,030	44,900-52,320	1928	1450-2840	58,100	57,160-58,880
Total Organic Carbon	136	13-322	39	<1-106	41	<1-142
Cyanide	0.05	<0.002-<0.1	0.04	<0.001-<0.1	0.04	<0.001-<0.1
Phenols	0.009	<0.001-0.04	0.02	<0.001-0.08	0.06	<0.001-0.3
Hydrogen Sulfide	44	<1-96	40	<1-120	27	<1-102
Calcium	295	156-400	17	<1-27	312	138-470
Magnesium	192	156-216	2.6	<1-6.2	264	190-350
Sodium	14,340	13,000-16,200	500	410-813	15,800	12,000-19,000
Sodium Absorption Ratio	184	130-222	40	23-95	182	92-282
Potassium	10	<1-14	2.0	<1-3.8	49	40-58
Iron[c]	5.4	1-11	0.47	0.04-2.5	0.22	0.03-0.6
Manganese[c]	13	10-15	0.73	0.60-1.0	0.64	0.50-0.78
Bicarbonate	2590	2318-2916	480	390-610	800	500-1015
Carbonate	0	0-0	0	0-0	0	0-0
Sulfate	29,600	28,000-31,360	686	460-1190	36,500	34,600-37,200
Chloride	688	623-728	27	5-40	1200	740-1394
Fluoride	7.7	1-13	2.8	<1-5	9.8	3.0-15
Nitrate (as N)	10.7	0.02-40	4.0	<0.1-1.0	8.1	0.02-18
Silica (as SiO_2)	23	6.0-41	12	8.0-13	13	11-18
Phosphate (as P)	2.3	0.2-6	3.0	0.3-13	1.1	0.2-3
Aluminum[c]	0.07	<0.02-0.2	0.05	<0.02-0.1	0.05	<0.02-0.1
Arsenic[c]	0.18	<0.02-1.0	0.02	<0.01-<0.02	0.15	<0.02-0.8
Boron[c]	3.3	2.2-4.5	0.13	<0.02-0.2	0.5	<0.02-0.8
Barium[c]	6.1	<0.01-26	0.92	<0.02-2.0	1.1	0.1-3.0
Cadmium[c]	0.02	0.003-0.08	0.15	<0.001-<0.01	0.02	0.003-0.08
Chromium[c]	0.06	0.02-0.1	0.016	0.002-0.03	0.06	0.01-0.12
Cobalt[c]	0.07	0.02-0.2	0.017	0.01-0.03	0.05	<0.02-0.17
Copper[c]	0.54	0.009-2.9	0.23	0.002-1.3	0.42	<0.02-1.9
Lead[c]	0.22	0.003-1.0	0.014	0.002-0.02	0.21	0.004-0.7
Mercury (total)	0.003	<0.0002-0.017	0.001	<0.0001-0.004	0.009	<0.0001-0.06
Molybdenum[c]	0.012	0.001- 0.02	0.017	0.005-0.03	0.04	<0.001-0.23
Nickel[c]	0.25	0.02-1.2	0.017	<0.01-0.02	0.29	<0.02-1.6
Selenium[c]	0.23	0.01-1.5	0.01	<0.01-<0.01	0.25	<0.01-0.7
Silver[c]	0.02	<0.01-0.04	0.02	<0.01-<0.02	0.02	<0.01-0.04
Vanadium[c]	0.01	<0.01-0.02	0.01	<0.01-0.01	0.02	<0.01-0.06
Uranium[c]	0.29	0.003-0.68	0.02	<0.001-0.09	0.21	0.002-0.47
Zinc[c]	0.34	<0.01-1.9	0.19	<0.01-1.2	0.22	<0.01-0.95
Radium-226 (pCi/i)[c]	1.5	<0.6-3.9	1.1	0.2-5.0	3.3	<0.6-8.1
Radium-228 (pCi/i)[c]	2.6	<1-12	1.3	<1-3.0	2.0	<1-4

Table 5-4. WATER QUALITY IN THE PNM ALLUVIAL WELLS NEAR THE PLANT SITE (concluded)

Location	T.23N., R13W. 14		T.23N., R.13W. 14		T.23N., R13.W. 12	
Name	PNM A-5		PNM A-6		PNM A-7	
Dates	6/28/79-12/18/80		6/29/79-12/18/80		10/18/79-12/17/80	
Water Quality Parameter[a]	Avg.	Range	Avg.	Range	Avg.	Range
Temperature (°C)	13.2	11-14.5	12.8	10-14	13.8	12.5-16
pH (S.U.)	7.5	7.2-7.9	7.4	7.3-7.6	7.4	7-7.9
Specific Conductance[b]	4420	4180-4630	5680	5420-5790	2400	2300-2510
Total Dissolved Solids	5100	4484-5750	6580	4160-7260	242	2240-2720
Total Organic Carbon	31	<1-119	41	2-97	30	2-102
Cyanide	0.05	<0.001-<0.1	0.05	<0.001-<0.1	0.05	0.001-<0.1
Phenols	0.02	<0.001-0.8	0.08	<0.001-0.5	0.02	<0.001-0.08
Hydrogen Sulfide	49	<1-124	50	<1-116	46	<1-122
Calcium	31	10-56	87	16-140	31	19-53
Magnesium	10	4-17	46	37-60	6	3-10
Sodium	1570	1200-2090	1960	1700-2200	720	567-820
Sodium Absorption Ratio	73	47-128	49	32-71	33	22-44
Potassium	8	1-14	7	<1-11	3.0	<1-4
Iron[c]	0.4	<0.02-1.9	0.4	<0.02-1.7	1.3	0.54-2.0
Manganese[c]	0.5	0.2-1.3	2.8	2-3.8	2.1	1.4-3.0
Bicarbonate	842	690-1060	853	722-1000	1030	780-1163
Carbonate	0	0-0	0	0-0	0	0-0
Sulfate	2540	2150-2924	3970	3125-4360	680	420-820
Chloride	141	120-160	49	38-74	67	57-74
Fluoride	3.2	<1-5.9	4.9	2.0-7.1	1.7	<1-2.4
Nitrate (as N)	2.5	<0.1-7.2	3.1	<0.1-12	5.2	<0.1-13
Silica (as SiO_2)	9.4	8.0-12	12	8.0-16	19	15-21
Phosphate (as P)	1.2	0.3-2.9	1.8	0.2-4.9	1.2	0.2-3.0
Aluminum[c]	0.05	<0.02-0.1	0.05	<0.02-0.1	0.05	<0.02-<0.1
Arsenic[c]	0.14	<0.02-0.3	0.3	<0.02-2.0	0.01	<0.01-<0.02
Boron[c]	0.42	<0.02-0.7	0.3	<0.02-0.4	0.3	0.1-0.4
Barium[c]	1.2	0.1-3.6	2.8	0.01-10	2.0	0.2-6.0
Cadmium[c]	0.006	<0.001-<0.01	0.02	0.001-0.08	0.01	<0.001-0.04
Chromium[c]	0.014	0.002-0.02	0.02	0.008-<0.02	0.01	0.002-<0.02
Cobalt[c]	0.017	0.01-0.02	0.02	0.01-0.03	0.02	0.01-<0.02
Copper[c]	0.2	0.005-1.3	0.09	0.005-0.48	0.04	0.002-0.1
Lead[c]	0.14	0.002-<0.02	0.03	0.002-0.09	0.02	0.009-0.02
Mercury (total)	0.001	<0.0001-0.006	0.0006	<0.0001-0.003	0.0003	<0.0001-0.0004
Molybdenum[c]	0.015	<0.001-0.02	0.02	0.002-0.02	0.01	0.001-<0.02
Nickel[c]	0.03	<0.02-0.07	0.03	<0.02-0.1	0.04	<0.01-0.09
Selenium[c]	0.03	<0.01-0.08	0.04	<0.01-0.1	0.01	<0.01-0.03
Silver[c]	0.02	<0.01-0.02	0.02	<0.01-<0.02	0.02	<0.01-<0.02
Vanadium[c]	0.01	<0.01-0.01	0.01	<0.01-0.02	0.01	<0.01-<0.01
Uranium[c]	0.08	<0.002-0.02	0.01	<0.002-0.03	0.004	<0.001-0.01
Zinc[c]	0.13	<0.01-0.76	0.01	<0.01-0.76	0.3	<0.01-1.6
Radium-226 (pCi/i)[c]	0.5	<0.2-0.7	0.6	<0.2-0.8	0.5	<0.4-<0.6
Radium-228 (pCi/i)[c]	1.0	<1-<1	1.0	<1-<1	1.0	<1-<1

Source: PNM 1981.

[a] All units in mg/l unless otherwise indicated.

[b] μmhos/cm at 25°C.

[c] These concentrations are dissolved.

Well A-1 was the only well where TDS values were below the state groundwater standard of 1,000 mg/l, and TDS values at all wells except A-1, A-3, and A-7 exceeded the recommended stockwater criterion of 3,000 mg/l. Sodium adsorption ratios (SAR) for nearly all well samples exceeded the maximum SAR value of 18 recommended for most irrigation uses. Chloride concentrations in several wells (i.e., A-1, A-3, A-5, A-6, and A-7) were below the state standard of 250 mg/l, but fluoride concentrations in all wells exceeded the standard level of 1.6 mg/l at least once during the sampling period. Sulfate concentrations were below the state standard of 600 mg/l only in Wells A-1, A-7, and PC-2. Nitrate concentrations measured varied widely at each well, with maximum concentrations exceeding the state standard of 10 mg/l at all wells except A-5. Arsenic concentrations in all wells except A-3, A-7, and PC-1 exceeded the state standard of 0.1 mg/l at least once during the sampling period. The state standard of 0.75 mg/l for boron was exceeded only at Wells A-2, A-4, and PC-1. Barium concentrations fluctuated widely and at least one value observed at every well exceeded the standard of 1.0 mg/l.

Concentrations of most trace elements (i.e., cadmium, chromium, copper, cobalt, iron, lead, manganese, mercury, nickel, and selenium) exceeded state standards on some occasions during the sampling period. The most common occurrences of relatively high trace element concentrations were observed at Wells A-2 and A-4, the two alluvial wells with very low permeabilities and very high salt levels. Uranium and radium concentrations never exceeded the state standards of 5 mg/l and 30 pCi/l, respectively. All cyanide concentrations measured were below the standard of 0.1 mg/l, but on occasion, concentrations of phenol, a trace organic compound found in coal, exceeded the state standard of 0.005 mg/l.

In summary, trace element concentrations fluctuated over rather wide ranges during the June 1979 through December 1980 period. To summarize the comparison of well water quality to New Mexico groundwater standards, Table [5-5] presents a list of standards and indicates which of these standards were exceeded at least once during the sampling period.

Water quality data for other alluvial wells that could be affected by mining operations and the disposal of plant solid wastes are listed in Table 5-6. As Table 5-6 shows, the water quality in other alluvial wells (downstream of proposed plant site and mining activities) is quite a bit better than that found in the PNM monitoring wells near the proposed plant site. The alluvial ground-water downstream of the site is much lower in common mineral constituents and trace elements than the water found near the plant site in PNM wells. Downstream alluvial ground-water meets appropriate quality criteria for stock watering and irrigation. The water from these wells also appears to be suitable for domestic use, although the TDS standards are consistently exceeded slightly and the sulfate and fluoride standards are slightly exceeded on occasion.

Table 5-5. WELL SAMPLES WITH WATER QUALITY IN EXCESS OF NEW MEXICO GROUND-WATER QUALITY STANDARDS[a]

Parameter	A-1	A-2	A-3	A-4	A-5	A-6	A-7	PC-1	PC-2
TDS		X	X	X	X	X	X	X	X
Chloride		X		X				X	X
Fluoride	X	X	X	X	X	X	X	X	X
Sulfate		X	X	X	X	X	X	X	
pH									
Nitrate	X	X		X			X	X	X
Aluminum									
Arsenic	X	X		X	X	X			X
Boron		X		X				X	
Barium	X	X	X	X	X	X	X	X	X
Cadmium		X		X		X	X		X
Chromium		X		X					
Copper	X	X	X	X	X				
Cobalt		X		X					
Iron	X	X	X	X	X	X	X		
Lead		X		X		X			
Manganese	X	X	X	X	X	X	X		
Mercury	X	X	X	X	X	X	X		
Nickel				X					
Selenium		X		X	X	X			
Silver									
Uranium									
Zinc									
Cyanide									
Phenol	X	X	X	X	X	X	X	X	X
Radium-226 and-228									

Source: PNM 1981.

[a]New Mexico ground-water standards are listed in Table 5-3.

Table 5-6. WATER QUALITY OF OTHER SELECTED ALLUVIAL WELLS DOWNSTREAM OF PLANT AND MINE FACILITIES

Location	T.24N.,R.13W.,32.a	T.23N.,R13W.,1		T.23N.,R.13W.,17.3432	T.23N.,R.13W.,19.2132
Name or Number	13R-137	PNM A-1		13R-55A	13R-55
Date	9/20/49	6/27/79-12-17-80		5/10/76	5/4/55
Water Quality Parameter		Avg.	Range		
General Constituents					
pH, S.U.	—	7.8	7.4-8.3	8.1	7.9
Temperature (°C)	18	13	11-14.5	13.5	9
Specific Conductance (μmhos/cm at 25°C)	2060	1010	945-1050	1490	1660
Total Dissolved Solids	1470	777	480-975	—	1000
Hardness	234	—	—	140	90
Alkalinity		—	—	—	—
Total Organic Carbon		30	<1-110	—	—
Sodium Adsorption Ratio		16	4-27	—	—
Common Ions					
Calcium	81	17	<1-38	49	26
Magnesium	7.9	2.0	<1-4	4.7	5.9
Sodium	420	300	260-357	280	317 (Na+K)
Potassium	—	3.3	<1-11	1.7	
Iron[a]	—	0.6	0.05-2.4	—	—
Manganese[a]	—	0.16	0.006-0.44	—	—
Bicarbonate	522	420	363-465	285	355
Carbonate	0	0	0-0	0	0
Sulfate	661	260	110-340	460	442
Chloride	16	43	10-92	12	12
Fluoride	1.0	2.2	<1-3.9	1.5	1.7
Nitrate (as N)	7.4	8.9	<1-20	—	7.0
Boron[a]	—	0.2	<0.02-0.6	—	—
Silica (as SiO_2)	19	12	11-13	11	13
Trace Materials[a]					
Aluminum	—	0.05	<0.02-0.1	—	—
Arsenic	—	0.2	<0.01-1.0	—	—
Barium	—	1.2	<0.02-4.2	—	—
Cadmium	—	0.006	<0.001-0.01	—	—
Chromium	—	0.03	<0.001-0.12	—	—
Cobalt	—	0.02	0.01-0.02	—	—
Lead	—	0.01	0.003-<0.02	—	—
Mercury (total)	—	0.002	0.0004-0.008	—	—
Molydenum	—	0.05	<0.02-0.18	—	—
Nickel	—	0.02	<0.01-<0.02	—	—
Selenium	—	0.01	<0.01-<0.01	—	—
Silver	—	0.02	<0.01-<0.02	—	—
Vanadium	—	0.01	<0.01-0.01	—	—
Uranium	—	0.02	<0.001-0.08	—	—
Zinc	—	0.66	<0.01-4.3	—	—
Radium-226 (pCi/l)	—		<0.6-5.6	—	—
Radium-228 (pCi/l)	—		<1-2.0	—	—

Table 5-6. WATER QUALITY OF OTHER SELECTED ALLUVIAL WELLS DOWNSTREAM OF PLANT AND MINE FACILITIES (continued)

Location	T.23N.,R.13W.,17.334[c]		NR066.0285x0391[c]	NR066.0415x0331[c]
Name or Number	De-Na-Zin Wash		15-9-11	U-20
Date	12/20/77-9/21/79		5/22/76	5/11/76
Water Quality Parameter	Avg.	Range		
General Constituents				
pH, S.U.	80	7.6-9.3	7.7	7.7
Temperature (°C)	11	8-20.0	14.5	15.0
Specific Conductance (μmhos/cm at 25°C)	1860	1760-1940	1550	2700
Total Dissolved Solids	1270	1170-1370	4010	1800
Hardness	180	160-210	170	210
Alkalinity	292	235-317		
Total Organic Carbon	—	—	—	—
Sodium Adsorption Ratio	12	11-12	9.6	16
Common Ions				
Calcium	64	55-73	58	66
Magnesium	6.7	5.8-7.5	6.8	10
Sodium	360	330-380	290	540
Potassium	3.0	2.5-4.0	4.0	4.7
Iron[a]	0.022	.01-0.03	0.03	0.04
Manganese[a]	0.028	0.023-0.04		
Bicarbonate	335	276-387	499	659
Carbonate	0	0	0	0
Sulfate	620	560-690	380	800
Chloride	21	16-31	14	34
Fluoride	0.9	0.8-1.2	0.8	1.2
Nitrate (as N)	3	2.8-3.3(NO_2 + NO_3)	0.11	0.70
Boron[a]	0.08	.070-0.90	0.08	0.1
Silica (as SiO_2)	12	9.2-15	13	15
Trace Materials[a]				
Aluminum	0.03	0.03-0.03	---	---
Arsenic	0	0-0	---	---
Barium	0.05	0-0.1	---	---
Cadmium	0.003	0.002-0.004	---	---
Chromium	0	0-0	---	---
Cobalt	0.001	0-<0.003	---	---
Lead	0.004	0-0.009	---	---
Mercury (total)	0	0-0	---	---
Molydenum	0.005	0.003-0.006	---	---
Nickel	0.001	0.0-0.002	---	---
Selenium	0.005	0.004-0.006	---	---
Silver	0	0.0	---	---
Vanadium	0.93	0.98	---	---
Uranium	—	—	---	---
Zinc	0.89	0.38-1.4	---	---
Radium-226 (pCi/l)	---	---	---	---
Radium-228 (pCi/l)	---	---	---	---

Table 5-6. WATER QUALITY OF OTHER SELECTED ALLUVIAL WELLS DOWNSTREAM OF PLANT AND MINE FACILITIES (concluded)

Location Name or Number Date Water Quality Parameter	NR066.0512x0403[c] E-97 6/16/76	NR066.0330x0379[b] 15A-21 2/16/55
General Constituents		
pH, S.U.	7.8	—
Temperature (°C)	14.0	4.4
Specific Conductance (μmhos/cm at 25°C)	2420	1490
Total Dissolved Solids	1630	—
Hardness	160	206
Alkalinity	—	—
Total Organic Carbon	4.6	—
Sodium Adsorption Ratio	17	—
Common Ions		
Calcium	52	—
Magnesium	8.2	—
Sodium	500	—
Potassium	4.6	—
Iron[a]	0.01	
Manganese[a]		
Bicarbonate	623	534
Carbonate	0	0
Sulfate	710	—
Chloride	30	23
Fluoride	1.4	1.4
Nitrate (as N)	0.70	6.5
Boron[a]	0.1	—
Silica (as SiO_2)	16	—
Trace Materials[a]		
Aluminum	—	—
Arsenic	—	—
Barium	—	—
Cadmium	—	—
Chromium	—	—
Cobalt	0.1(total)	—
Lead	0.2(total)	—
Mercury (total)	—	—
Molydenum	—	—
Nickel	0(total)	—
Selenium	—	—
Silver	—	—
Vanadium	—	—
Uranium	—	—
Zinc	—	—
Radium-226 (pCi/l)	—	—
Radium-228 (pCi/l)	—	—

NOTE: All units mg/l unless otherwise noted.

[a]Dissolved.

[b]From Geohydrology Associates 1980.

[c]From USGS 1975-1980.

The other groundwater-bearing unit that potentially could be affected by the construction and operation of the plant and mine facilities is the Pictured Cliffs Sandstone. As discussed in the Geologic and Seismic Hazards Technical Report, this formation crops out over much of the plant site and dips 0.5° to the north, thereby underlying the coal-bearing Fruitland Formation at the mine site. Underlying the Pictured Cliffs Sandstone is the Lewis Shale, which forms a confining bed between the Pictured Cliffs Sandstone and the Cliff House Sandstone. The water quality of a number of wells penetrating the Pictured Cliffs Sandstone is shown in Table 5-7.

As Table 5-7 shows, the overall water quality (as measured by TDS concentrations) in the Pictured Cliffs Sandstone is much more consistent than that in the alluvium. Sodium was the dominant cation, while chloride was the dominant anion for higher-TDS waters. For lower-TDS waters, sulfate was the dominant anion. Chloride dominance of the anion content contrasts markedly with the sulfate dominance of the alluvial waters. A comparison of the water quality in the Pictured Cliff Sandstone monitoring wells (PC-1 and PC-2) and state ground-water standards and applicable water quality criteria has already been presented. As Table 5-7 shows, water from other wells penetrating the Pictured Cliffs Sandstone also exceeded quality standards and criteria. For instance, water from wells penetrating this sandstone formation has a high sodium adsorption ratio and high concentrations of TDS, sodium, sulfate, chloride, fluoride, chromium, and lead. It should be noted that the quality of a downgradient well is much worse than that of wells near the outcrop.

Data on the quality of water in an outcrop area of the Fruitland Formation are presented in Table 5-8. The water quality of these wells is poor; the waters are sodium sulfate in character, with high levels of TDS and nutrients. Based on TDS content, these waters are not acceptable for drinking water, stock water, or irrigation. Sulfate levels are well above the 600 mg/l state standards; the state chloride standard is also exceeded. Nitrate levels were measured at levels high enough to impair drinking-water use.

Table 5-7. WATER QUALITY IN THE PICTURED CLIFFS SANDSTONE

Location	T.23N., R.13W.,1[a]		T.23N., R.13W.,10[a]		T.23N., R.12W.,7.2333[b]		T.23N., R.12W., 8.2111[b]	
Name	PC-1		PC-2		Bisti DH3		Bisti DH7 (E-41)	
Sampling Date	6/27/79-12/17/80		6/27/79-12/17/80		8/20/75-6/15/76		8/20/75-6/15/76	
Water Quality Parameter	Avg.	Range	Ave.	Range	Ave.	Range	Ave.	Range
General Constituents								
pH, S.U.	7.4	7.1-7.7	7.8	7.4-8.3	8.7	8.2-9.6	9.3	8.0-10.9
Temperature (°C)	16.6	14-20	16.5	14-19	17	16-18	18.1	15.5-21.5
Specific Conductance (μmhos/cm at 25°C)	6430	6030-7070	4760	4270-4920	6940	6500-7200	—	7800(6/15/76)
Total Dissolved Solids	5790	4712-8120	3550	2960-4160	4180	3890-4620	4240	4160-4390
Hardness	—	—	—	—	41	23-62	42	27-70
Alkalinity	—	—	—	—	—	—	—	—
Total Organic Carbon	62	8-110	29	3-106	12	12	31	14-29
Sodium Adsorption Ratio (SAR)	64	57-78	127	69-261	109	88-135	116	83-143
Common Ions								
Calcium	46	36-56	11	<1-20	9.2	4.1-15	12.7	4.8-23
Magnesium	22	8-82	4	1-11	4.4	3.2-6.0	2.5	0.4-3.6
Sodium	1900	1800-2000	1360	1188-1550	1530	1500-1600	1625	1600-1700
Potassium	12	11-15	7	<1-13	9.8	9.4-10	10.2	9.2-11
Iron	0.07	<0.02<0.2	0.06	<0.02-0.29	0.06	0.02-0.09	0.08	0.05-0.14
Manganese	0.04	<0.01-0.12	0.02	0.003-0.05	—	—	0.05	0.05[d]
Bicarbonate	438	317-610	644	560-925	459	302-543	184	96-319
Carbonate	0	0-0	0	0-0	43	0-129	16	0-62
Sulfate	925	450-1250	150	10-170	550	65-1500	168	120-190
Chloride	2120	1930-2352	1850	1770-2000	1800	1200-2100	2300	2300-2300
Fluoride	2.5	1.1-3.8	3.5	2.0-4.9	1.9	1.4-2.7	1.8	1.2-2.1
Nitrate	3.7	<0.1-11	3.5	0.1-13	1.1	0.7-2.8	1.4	0.3-4.2
Boron	0.7	0.3-0.9	0.5	0.4-0.6	.45	0.43-0.47	0.4	0.37-0.49
Silica (as SiO_2)	5.6	1-9.0	8.8	8.0-11	6.3	3.3-8.6	4.9	3.9-6.6
Trace Materials								
Aluminum	0.06	<0.02<0.1	0.05	<0.02<0.1	—	—	—	—
Arsenic	0.02	<0.01-0.02	0.09	<0.01-0.5	0.018[d]	0.011-0.03[d]	0.009[d]	0.005-0.017[d]
Barium	1.0	0.2-4.4	1.7	<0.02-6.4	—	—	—	—
Cadmium	0.007	0.001<0.01	0.01	0.001-0.04	—	—	0.015[d]	0.01-0.02[d]
Chromium	0.02	0.003<0.02	0.01	<0.001<0.02	—	—	0.015[d]	0.03[d]
Cobalt	0.02	<0.01-0.02	0.02	<0.01<0.02	—	—	—	—
Lead	0.02	0.006-0.03	0.01	<0.001<0.02	0.1[d]	0-0.1[d]	0.27[d]	0.2-0.4[d]
Mercury (total)	0.002	<0.0001-0.01	0.0005	<0.0001-0.002	0.0001[d]	0-0.0002[d]	0.0004[d]	0-0.001[d]
Molydenum	0.001	0.002-0.03	0.01	<0.001<0.02	—	—	—	—
Nickel	0.02	<0.01-0.05	0.02	<0.01-0.02	—	—	—	—
Selenium	0.01	<0.01-0.02	0.01	<0.01-0.02	0.001[d]	0-0.002[d]	—	0-0.001[d]
Silver	0.02	<0.01- 0.02	0.02	<0.01- 0.02	—	—	—	—
Vanadium	0.01	<0.01	0.01	<0.01	—	—	—	—
Uranium	0.007	<0.001-0.02	0.005	<0.002-0.01	—	—	—	—
Zinc	0.2	<0.01-1.1	0.08	<0.1-0.48	—	—	—	—
Radium-226 (pCi/l)	0.6	<0.2-1.2	0.7	<0.2-1.1	—	—	—	—
Radium-228 (pCi/l)	1.0	<1-1.1	1.0	1	—	—	—	—
Cyanide	0.05	<0.001<0.1	0.04	<0.001<0.1	—	—	—	—
Phenols	0.03	0.001-0.08	0.12	<0.001-0.6	—	—	—	—
Hydrogen Sulfide	38	<1-136	70	<1-196	—	—	—	—
Phosphate (as P)	1.1	0.2-2.4	1.2	0.3-3.0	—	—	—	—
Copper	0.28	0.003-1.0	0.22	<0.001-0.85	—	—	0.51[d]	0.18-0.84[d]

Table 5-7. WATER QUALITY IN THE PICTURED CLIFFS SANDSTONE (concluded)

Location	T.23N.,R.12W.,18.233[b]		T.23N.,R12W.,17.2111[b]		T.24N.,R13W.,9.1343[c]
Name	BIA 19 T-507		Bisti DH		19R-325
Sampling Date	4/1/75-6/6/76		3/31/76-6/15/76		2/23/67
Water Quality Parameter	Avg.	Range	Avg.	Range	
General Constituents					
pH	8.7	8.4-8.9	9.0	8.7-9.2	8.1
Temperature (°C)	9.8	4-21.5	17.5	16.5-18	—
Specific Conductance (umhos/cm at 25°C)			—	5700(6/15/76)	12,000
Total Dissolved Solids	1860	1700-2150	3530	3530-3530	7014
Hardness	13	12-14	42	36-49	190
Alkalinity	—	—	—	—	—
Total Organic Carbon	4.8	4.8	28	22-34	—
Sodium Absorption Ratio	81	75-93	81	75-87	—
Common Ions					
Calcium	3.2	3-3.5	13	11-15	60
Magnesium	1.3	1.1-1.6	2.4	2-2.8	9.7
Sodium	680	600-790	1200	1200-1200	2621
Potassium	2.8	2.3-3.2	5.7	5.4-6.0	—
Iron	0.08	0.09-0.1	0.07	0.03-0.11	0.04
Manganese	—	—	—	—	—
Bicarbonate	610	596-632	217	208-226	743
Carbonate	51	42-62	4	0-8	33
Sulfate	753	680-890	1550	1500-1600	82
Chloride	61	50-73	640	590-690	3752
Fluoride	1.3	1.2-1.5	3.8	3.5-40	0.7
Nitrate	0.31	0.04-0.59	0.04	0.04-0.04	0.37
Boron	0.26	0.23-0.27	0.36	0.34-0.37	1.02
Silica (as SiO_2)	7.6	6.7-8.9	4.4	4.3-4.5	—
Trace Materials					
Aluminum	—	—	—	—	—
Arsenic	0.001[d]	0.001[d]	0.011[d]	0.008-0.014[d]	—
Barium	—	—	—	—	—
Cadmium	0.01[d]	<0.01[d]	—	—	—
Chromium	0.12[d]	0.23[d]	—	—	—
Cobalt	—	—	—	—	—
Lead	—	—	0.2[d]	0-0.2[d]	—
Mercury (total)	0	0-0[d]	0.0002[d]	0.0002-0.0003[d]	—
Molydenum	—	—	—	—	—
Nickel	—	—	—	—	—
Selenium	0[d]	0-0[d]	0.001[d]	0.001-0.001[d]	—
Silver	—	—	—	—	—
Vanadium	—	—	—	—	—
Uranium	—	—	—	—	—
Zinc	—	—	—	—	—
Radium-226 (pCi/l)	—	—	—	—	—
Radium-228 (pCi/l)	—	--	—	—	—
Cyanide	—	—	—	—	—
Phenols	—	—	—	—	—
Hydrogen Sulfide	—	—	—	—	—
Phosphate (as P)	—	—	—	—	—
Copper	0.01[d]	0.01[d]	—	—	—

Note: All units mg/l unless otherwise noted.

[a]From PNM 1981.

[b]From USGS 1975-1980.

[c]From Geohydrology Associates 1980.

[d]Total.

Table 5-8. AVERAGE WATER QUALITY OF WELLS IN THE FRUITLAND FORMATION NEAR THE MINE

Well Data		
Location	T.23N.,R.12W.7.200	T.23N.,R.12W.8.100
Name	TL7-2 COA	TL8-1 OB
Date	10/19/76 & 3/2/77	10/19/76 & 3/3/77
Water Quality Parameters[a]		
General Constituents		
pH, S.U.	8.1	7.6
Temperature, °C	16	13
Specific Conductance (umhos/cm at 25°C)		
Total Dissolved Solids	5440	11850
Hardness	90	880
Total Organic Carbon	55	50
Chemical Oxygen Demand	240	170
Sodium Absorption Ratio, unitless	87	52
Common Ions		
Calcium	24	300
Magnesium	7.2	32
Sodium	1900	3600
Potassium	12	16
Iron	—	0.04
Manganese	—	—
Bicarbonate	1360	670
Carbonate	0	0
Sulfate	2400	7500
Chloride	420	64
Fluoride	1.2	0.4
Silica	8.8	7.9
Boron	—	0.61
Nutrients		
Nitrate (as N)	0.06	10.0
Nitrite (as N)	0.0	0.52
Ammonia (as N)	1.6	2.9
Total Nitrogen (as N)	3.4	16.0
Total Phosphorus (as P)	0.21	0.13
Orthophosphorus (as P)	0.02	0.02
Trace Materials		
Arsenic, dissolved	0.002	0.001
Lead, total	0.15	0.3
Lead, dissolved	0.024	0.004
Mercury, total	0.0002	0.0003
Selenium, dissolved	0.001	0.002
Gross-Alpha, dissolved (as U-nat)	0.073	0.184
Gross-Alpha, suspended (as U-nat)	0.057	0.047
Gross Beta, dissolved (as Cs-137)(pCi/l)	21	23
Gross Beta, suspended (as Cs-137)(pCi/l)	20	16
Gross Beta, dissoled (as Sr-90)(pCi/l)	19	20
Gross Beta, suspended (as Sr-90)(pCi/l)	17	14
Radium-226, dissolved (pCi/l)	0.24	0.23
Natural Uranium, dissolved	0.0018	0.0025
Uranium, dissolved	—	0.0002

Source: USGS 1977.

[a]All units in mg/l unless otherwise indicated.

5.3 SURFACE-WATER QUALITY IMPACTS

5.3.1 Construction

Several activities during the construction of powerplant facilities could affect surface-water quality. Such activities include land disturbance leading to increased erosion, fuel spills, and disposal of sewage and other liquids generated during construction. As mentioned in the Project Description Technical Report, erosion control at the plant site would consist of controlled drainage ditches and slopes across disturbed areas that would tie into existing surface drainage features. Siltation control measures would include sedimentation ponds, sediment traps, and controlled drainage slopes. If these sediment control measures are 90 percent effective (Hittman Associates, 1976), there would be no increase in the sediment load from De-na-zin Wash, as the total yield from the site would be about the same as that occurring under natural conditions.

Earthern berms surrounding elevated storage tanks for diesel fuel or gasoline would limit the spread of spills from fuel-dispensing facilities. Occasional spills may also occur throughout the site, but they would not be expected to reach surface waters. All sewage produced during construction would be treated by portable chemical toilets supplied and maintained by a local firm. Consequently, sewage disposal would have little or no effect on surface-water quality. Maintenance and cleaning of concrete trucks is expected to occur at an off-site location determined by the concrete supplier, thus limiting the potential for spills or accidental discharge of concrete wash waters. Miscellaneous spills of cleaning fluids, waste oils, and other liquids could occur during the construction of the project. The construction contractors would be responsible for limiting their frequency and amount, and for subsequent cleanup if required.

5.3.2 Operation

As discussed in the project description, no surface-water discharges would be expected from the plant under normal operating conditions. Because it may not be possible to contain (on-site) all effluents resulting from off-design or upset or, high rainfall conditions, PNM may apply for a discharge permit.

The U.S. EPA Region VI office in Dallas, Texas, is responsible for granting discharge permits under the National Pollutant Discharge Elimination System (NPDES) permit system. If a discharge were to be contemplated, it would have to meet the New Source Performance Standards (NSPS) for the Steam Electric Power Generating Point Source Category. These standards were proposed in October 14, 1980 (45 FR 68328) and are expected to be promulgated sometime in mid-1982. The specific standards are listed in Table 5-9.

In addition, a potential discharge from the plant would have to conform to the "Policy for Implementation of the Colorado River Salinity Standards Through the NPDES Program," adopted by the Colorado River Basin Salinity Control Forum and approved by the EPA. As part of the salinity control program a limitation has been imposed by EPA, as part of the NPDES permit, on the total quantity of TDS discharged to the San Juan River. The limitation is presently 1 ton of TDS per day, or an average of 365 tons per year.

A schematic diagram of the proposed water management facilities is shown in Figure 5-2, and the individual processes are identified in Table 5-10. As one can see from the figure, most of the water drawn from the water storage reservoir would go through a softening process, although some raw water would serve as make-up to the bottom ash transport and scrubber operations. Most of the softened water would be lost to the atmosphere in the cooling towers; most of the tower blowdown along with plant drainage would serve as scrubber-tower demister wash water, and some would be used in the scrubber additive tank. Most of the water input (raw water, cooling-tower blowdown, incoming flue gas moisture, and plant drainage) to the scrubber system would be lost to the atmosphere.

At a 65 percent annual capacity factor, 90 percent of the scrubber input water would be lost to the atmosphere. About half of the remaining 10 percent would be sent to either evaporation ponds or brine concentrators. The remaining water would be incorporated into the ash and scrubber-sludge solid waste mixture. Although most of the softened water would be used in the cooling towers, some would be used (after appropriate treatment) in the boiler condensate and feedwater systems, and some would be used to provide for plant uses outside the steam cycle. About half the incoming water going to the steam cycle and plant service

Table 5-9. PROPOSED NEW SOURCE PERFORMANCE STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY

Discharge Description	NSPS Effluent Limitations		
All discharges	pH shall be within the range of 6 to 9, except for cooling-water discharges.		
All discharges	No discharge of polychlorinated biphenyl compounds.		
Low-volume waste		Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
	Total suspended solids	100.0	30.0
	Oil and grease	20.0	15.0
Metal-cleaning wastes	Total suspended solids	100.0	30.0
	Oil and grease	20.0	15.0
	Copper, total	1.0	1.0
	Iron, total	1.0	1.0
Bottom ash transport water	Total suspended solids	100.0	30.0
	Oil and grease	20.0	15.0
Coal-pile runoff	Total Suspended Solids	50.0	--
Coal-pile runoff	Any untreated overflow from facilities designed, constructed, and operated to treat coal-pile runoff that results from a 10-year, 24-hour rainfall event shall not be subject to the above limitations.		
Fly ash transport water	No discharge of copper, nickel, zinc, arsenic, and selenium from fly ash transport water.		
Cooling-tower blowdown	No discharge of cooling-tower maintenance chemicals containing the 129 priority pollutants.		
Once-through cooling water	No discharge of total residual chlorine (or total chlorine oxidants), however, if a facility can show the Regional Administration that the facility must use chlorine for condenser biofouling control, it may discharge the minimum amount of total residual chlorine necessary to operate the facility. If such a showing is made, the following maximum concentration of total residual ore is allowable: 0.14 mg/l for once-through cooling-water chlorine and cooling-water blowdown.		

Source: 45 FR 68328; October 14, 1980.

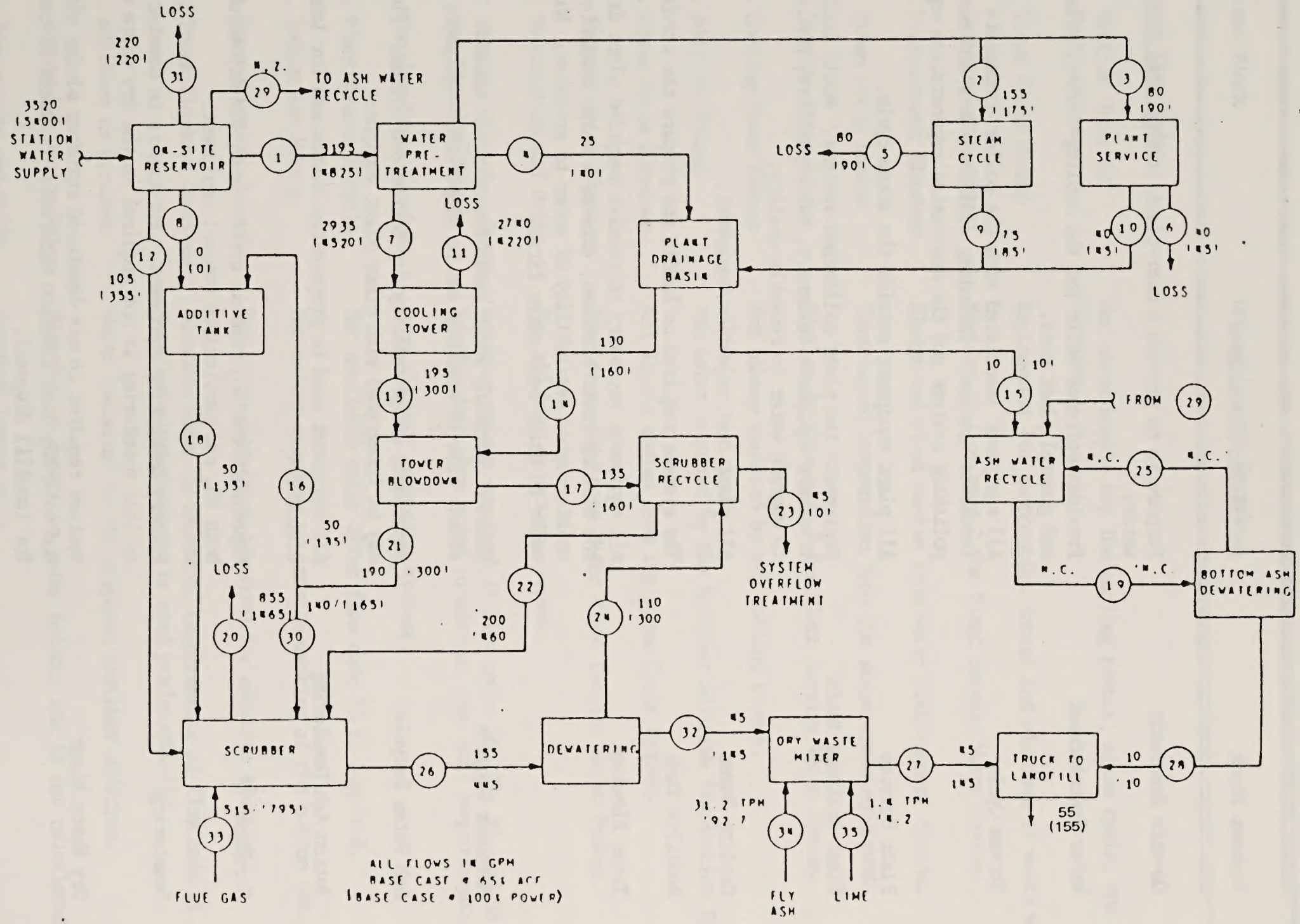


Figure 5-2. PROCESS FLOW DIAGRAM FOR THE BASE CASE WATER MANAGEMENT SYSTEM PER UNIT

Table 5-10. DEFINITION OF PROCESS BLOCKS AND FLOW NODES SHOWN ON FIGURE 5-2

Process Block	Definition and Remarks
On-site Reservoir	Purpose is to provide a near-plant storage area for make-up water.
Water Pretreatment	Provides softened water for the cooling towers, steam cycle, and general plant uses.
Stream Cycle	All equipment associated with the boiler condensate and feedwater systems. Including demineralizers and condensate polishing systems and the associated regeneration equipment.
Plant Service	All plant equipment outside the steam cycle.
Plant Drainage Basin	Represents the plant collection systems. Would include any treatment equipment (skimmers, oil separators, etc.) required to upgrade water to reusable quality.
Cooling Tower	All plant heat rejection equipment.
Additive Tank	The systems required to handle and prepare the scrubber additive.
Tower Blowdown	All equipment necessary to receive recycled plant drainage and the cooling-tower blowdown; acts as a surge basin to ensure uninterrupted availability of water to scrubber. Will cascade water by using best water first.
Scrubber Recycle	Acts as cascading surge basin for scrubber makeup. Ensures steady flow to scrubber and to evaporation equipment.
Ash Water Recycle	Represents surge capacity for bottom ash system. Physically may be integrated with other plant equipment.
Bottom Ash Dewatering	All equipment used to prepare the bottom ash for landfill disposal.
Scrubber	Represents the SO_2 removal systems and, for dry scrubber case, both SO_2 and particulate removal equipment.
Dewatering	Primary dewatering equipment. Purpose is to dewater sufficiently so that dewatering is not required in the dry waste mixer.
Dry Waste Mixer	Systems required to mix dewatered scrubber sludge with fly ash and with any lime fixation material. Produces 75 percent solids for landfill disposal.
Truck to Landfill	All systems and equipment required to transport, unload, compact, and cover plant solid wastes.

Table 5-10. DEFINITION OF PROCESS BLOCKS AND FLOW NODES SHOWN ON FIGURE 5-2 (concluded)

Process Block	Definition and Remarks
Process Flow Nodes	
1. Settled Water to Pretreatment	Net water supply for the cooling towers, steam cycle, and plant services.
2. Steam Cycle Makeup	Replacement for evaporation losses and blowdown of waste water.
3. Service Water Makeup	Similar to flow node 2 for Plant Service Water System.
4. Pretreatment Blowdown	Sludge and other wastes from Water Pretreatment System.
5. Steam Cycle Losses	Unreclaimed evaporation from the steam cycle equipment.
6. Service Water Losses	Similar to flow node 5 for Plant Service Water System.
7. Cooling-Tower Makeup	Net makeup required by all cooling towers.
8. Additive Makeup	Net water required by the Scrubber Additive Preparation System.
9. Steam Cycle Blowdown	All liquid wastes from the Steam Cycle System.
10. Service Water Blowdown	Similar to flow node 9 for Plant Service Water System.
11. Evaporation and Drift	For all heat rejection systems.
12. Scrubber Pump Seal Water and Scrubber Makeup	Scrubber makeup required if flow nodes 18, 22, 30, and 33 are insufficient when added to minimum pump seal requirements.
13. Cooling-Tower Blowdown	From all heat rejection systems.
14. Plant Drains Recycle	Net available water after flow node 15 is supplied.
15. Bottom Ash Makeup	Net makeup required to provide wetting of the bottom ash.
16. Tower Blowdown Recycle	Use of cooling-tower blowdown for additive sluicing.
17. Tower Blowdown Overflow	Blowdown water in excess of requirements of flow node 21. Recycled plant drainage is used preferentially.
18. Additive to Scrubber	Water contained in the prepared scrubber additive.
19. Bottom Ash Sluice Water	Flow has no impact on water balance and is not calculated.
20. Evaporation and Drift	Scrubber losses only.
21. Tower Blowdown to Scrubber	Dedicated uses of plant drainage and cooling-tower blowdown waters.

systems would be lost to the atmosphere; the other half would be sent to the plant drainage basin.

The plant drainage basin serves an important function in collecting certain plant wastes and providing recycled water to other plant systems. The plant drainage system would collect sludge and other wastes from the water pretreatment system and all liquid wastes from the steam cycle and plant service water systems. As such, the wastes sent to the plant drainage system could include wastewaters from floor and yard drains, sanitary wastewater treatment system, laboratory and sampling activities, water pretreatment equipment, boiler-tube cleaning, and fireside and air preheater washings.

A recent symposium considered the applicability of the zero-discharge water management concept to thermal electric power plants. (Electric Power Research Institute 1981). In this symposium, the designers, owners, and operators of coal-fired electric power plants were brought together to exchange technical information on the design and operation of water management systems designed for zero discharge of pollutants. The need for such an exchange arose through the experiences of both designers and operators of plants that have not performed at design levels. The poor performance of these systems appears to be reflected in unplanned decreases in evaporation pond capacity, usually resulting in the need for new evaporation ponds. In other systems, though, the design flow rate was quite similar to the actual flow rate into the evaporation ponds. For those plants that experienced problems, the major areas that have led to excessive water losses include: (1) clarifier sludge decant flows; (2) condensate and potable-water storage-tank overflows; (3) excessive cooling-tower blowdown; (4) cooling-tower basin overflows; (5) ash system loading overflows and spillage; (6) plant drainage system overflows; (7) poor evaporation pond design; (8) poor equipment reliability; and (9) pump seals.

Although the plant would be designed to operate as a zero-discharge facility under normal operating conditions, situations may arise (caused, e.g., by some of the problems listed above) where such a discharge is necessary. If such a discharge occurred, it would have to meet NSPS concentration limitations for certain pollutants in selected waste streams. In addition, the discharge

would have to meet the salinity control program limitation on TDS discharge rates.

Because of the unplanned nature of discharges from the plant water/waste water management system, an exact estimate of the quality and/or quantity of pollutants that would be contributed to De-na-zin Wash during any one discharge can not be made. It can be said, though, that the total mass of TDS discharged would be limited to 365 tons per year. In addition, the total quantity of each pollutant (or pollutant property) controlled in the NSPS attributable to each waste source would not exceed the specified limitation for that waste source.

As cited in Table 5-11, specific waste streams that are regulated by NSPS include low-volume waste (these include, but are not limited to wastewaters from wet scrubber air pollution control systems, ion exchange water treatment system, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning waters and recirculating house service water systems), metal cleaning wastes, bottom ash transport water, coal-pile runoff, and cooling-tower blowdown. As stated previously, it is impossible to predict what the quality of these effluents would be. A discussion of the quality of coal-pile runoff is presented in Section 5.4. Typical chemical characteristics of some of the above wastes from other facilities are listed in Table 5-12. Of course, it must be realized that these characteristics may bear little resemblance to the actual chemical characteristics of an effluent from a specific waste source in the plant and undoubtedly bear little resemblance to a combined effluent.

The fate of a discharge would depend upon the hydrologic regime of De-na-zin Wash at that time and the nature of the discharge. As noted in the Hydrology Technical Report, De-na-zin Wash is an ephemeral stream in which there is no flow over 80 percent of the time. However, when flow does occur, discharge rates can be very large. Most of the time, then, discharges from the plant would flow down a dry De-na-zin Wash channel. The extent of movement of this discharge downstream would depend primarily on the quantity and rate of discharge. For short duration discharges, most of the water would infiltrate into the alluvium downstream of the effluent pipe. If the duration of the discharge

Table 5-11. TYPICAL CHEMICAL CHARACTERISTICS OF SELECTED WASTE STREAMS

Chemical Parameters	Boiler Blowdown	Ion Exchange Spent Regenerant	Evaporator Blowdown	Metal Cleaning Wastes*	Fireside Wash Water	Air Preheater Wash Water	FGD Mist Eliminator Wash Water	FGD Scrubber
pH	-	6.5 (1.7-10.6)	-	6.2 (0.5-10.5)	-	3.4 (3.2-3.5)	2.7-3.1	4.3-12.7
S.C. (μmhos/cm)	-	-	-		-	2883 (2700-3750)	(1300-2700)	-
Total Dissolved Solids	-	6057 (1894-9645)	-	27,847 (340-73,000)	5000	695 (606-746)	(1000-2200)	-
Total Suspended Solids	66.26	44 (3-305)	28.4	45 (8-2375)	250	-	-	2800-92500
Alkalinity	-	-	-	-	-	-	-	-
Acidity	-	-	-	-	-	-	(49-120)	-
Hardness	-	-	-	-	-	1490 (1400 - 1600)	(580-1100)	-
Chemical Oxygen Demand	-	-	-	2151 (<5-9900)	-	-	-	1-390
Oil and Grease	1.74	6.0 (0.13-22)	2.1	17 (<5-41)	-	3.05 (0.25-8.5)	-	-
Phosphorus	17.07	-	-	93 (1.2-260)	-	-	(0.03-0.11)	-
Ammonia-N	-	-	-	1010 (80-5200)	-	-	(0.21-0.34)	-
Iron	0.53	-	0.54	4300 (0.15-9800)	2500	436 (335-515)	0.07-5.8	-
Manganese	-	-	-	21.6 (0.01-29)	3.5	-	0.14-0.37	-
Arsenic	-	-	-	34 (0.008-307)	-	-	0.01-0.002	0.004-1.8
Cadmium	-	-	-	0.023 (0.001-0.051)	-	-	0.0013-0.0042	0.004-0.11
Chromium	-	-	-	5.9 (<0.005-26.5)	1.5	1.22 (1.0-1.45)	<0.05	0.015-0.5
Copper	0.14	-	0.39	630 (0.69-11700)	6.0	-	0.02-0.03	0.002-0.56
Lead	-	-	-	1.3 (0.1-5.2)	-	-	0.011-0.033	0.01-0.52
Mercury	-	-	-	2 (<0.0002-14.4)	-	-	<0.0002	0.0004-0.07
Nickel	-	-	-	136 (0-500)	70	24.5 (18-34.8)	<0.05	-
Selenium	-	-	-	<0.002-<0.004	-	-	0.012-0.024	0.0006-62.7
Zinc	-	-	-	129 (0.06-840)	4.0	1.23 (1.06-1.45)	0.02-0.14	0.01-0.59

*Metal Cleaning Waste Category included the following types of metal cleaning solutions: ammoniated citric acid, ammoniated EDTA, ammoniacal sodium bromate, hydrochloric acid without copper complexor, hydrochloric acid with copper complexor, and hydrooxyacetic/formic acid solutions.

Source: EPA (1980).

Table 5-12. RESULTS OF LABORATORY LEACHING STUDIES

Water Quality Parameters[a]	Concentration			
	Illinois No. 6		Montana	
	Avg.	Range	Avg.	Range
pH (s.u.)	2.8	2.1-3.8	6.8	4.6-8.3
Specific Conductance (μmhos/cm at 25°C)	1390	187-4320	291	27-670
Sulfate	980	213-4060	112	34.6-189
Iron	247	5.9-1470	-	0.10
Chromium, μg/l	17	0.16-54.7	5.7	0.11-49.4

Source: Davis and Boegly 1981.

[a]Concentrations are mg/l unless otherwise indicated.

was increased, the downstream movement of the flow would probably increase due to the saturation of soils underlying the wash channel.

The worst-case situation from a total pollutant loading standpoint would occur when a plant water/wastewater management system malfunction occurred in conjunction with a discharge from the coal-pile runoff pond. The quality of this discharge would depend on the quality of coal-pile runoff (see section 5-4) and the quality of the plant water/wastewater management system discharge. While the quality of this discharge cannot be predicted accurately, some characteristics of the discharge may be obtained from review of Table 5-11 and application of NSPS. It is evident from the table that metal cleaning wastes, fireside wash water and air preheater washwater generally have the poorest quality. However, because these wastes are produced intermittently and in small volume, their likelihood of discharge would be small. The most noticeable characteristic of other waters is their TDS content. It is likely that a wastewater discharge from the plant management system would have a much higher TDS content than found in De-na-zin Wash when it flows. The relative effect of discharge of this water and coal-pile runoff water (with a similiar TDS to De-na-zin Wash water) on the quality of water in De-na-zin Wash would depend on the quantity of water being discharged and the quantity flowing down the wash.

As discussed in the Hydrology Technical Report, the flow in De-na-zin Wash can reach quite high levels. It is likely that coal-pile runoff would only be discharged under high De-na-zin Wash flow conditions. If this were the case, discharge of coal-pile runoff would have little, if any, effect on De-na-zin Wash water quality. Given the high wash flow volumes, a discharge of both coal-pile runoff and water/wastewater management system water would probably have little effect on the De-na-zin water quality other than to slightly increase TDS levels.

Although exact estimates of the water quality impacts of potential individual discharges cannot be accurately assessed, the worst case annual discharge of 365 tons of TDS can be compared with the existing mass discharge rate of TDS from De-na-zin Wash. Based on USGS data collected during the water years from 1976-1980, the maximum annual discharge mass of 365 tons represents about 15% of the average annual TDS discharge of De-na-zin Wash below the

proposed power plant site. Further downstream along the Chaco River at Waterflow, just before the confluence of the San Juan River and the Chaco River, the maximum annual power plant TDS discharge represents about 0.6 percent of the average annual TDS discharge for the water years 1976 through 1980 (USGS, 1976-1980). Further downstream along the San Juan River at Shiprock, the 365 tons of annual TDS discharge represent about 0.05 percent of the annual TDS discharge of the San Juan River (EPA 1979).

Because of the difficulty in predicting the quantity or quality of effluent discharge that may result from off-design or upset conditions, intensive monitoring of such discharges should be required. A conceptual monitoring plan for assessing the potential effects of such discharges is listed in the Suggested Mitigation section.

In addition, surface water discharges from the plant would also be subject to the New Mexico Environmental Improvement Division's (EID) "Regulations for Discharges Onto or Below the Surface of the Ground" (NMWQCC 1981). A copy of these regulations is presented in Appendix B. As noted in these regulations, the New Mexico EID would require a discharge plan for discharges to ephemeral streams. In addition, a discharge plan may also be required for those constituents whose discharge is regulated as part of an NPDES permit if the director of the EID finds that a hazard to public health exists.

The discharge plan must be approved by the EID within 120 days after discharge from the proposed source is initiated. The discharge plan submitted to the EID for review and approval must contain detailed information on the quantity and quality of the discharge as well as descriptions of the pertinent characteristics of the receiving body and the suggested monitoring program. EID's review and approval of the discharge plan would ensure that water quality degradation would be negligible.

The location of the evaporation and storm drainage and coal-pile runoff ponds downgradient of the water management system, fuel and chemical storage areas, and process areas should enable surface spills to be contained within these ponds. As the storm runoff and coal-pile runoff pond has the capacity to recycle collected water back to the water management system, it is possible

that treatment of surface spills can be provided through the existing on-site treatment systems.

Another potential surface water quality impact is acidification of surface waters due to acid rain. A discussion of the technical uncertainties surrounding the formation, dispersion, and deposition of acid rain is presented in the Air Quality Technical Report. Because of these uncertainties it is not possible to predict to what extent, if any, the atmospheric emissions would contribute to or cause the acidification of high mountain lakes. The intensive monitoring and modeling efforts described in the Air Quality Technical Report should allow the technical community to better address this question before construction of NMGS has been initiated. Until that time, the potential effects of NMGS, if any, on high mountain lakes in Southern Colorado, cannot be assessed accurately.

As noted in the Air Quality Technical Report, acidification of surface waters in the San Juan Basin, itself, is unlikely due to the dry climate and the alkaline nature of area soils. The alkaline nature of soils tends to increase precipitation pH values and acts to neutralize acids carried by precipitation. The dry climate limits the amount of acid rain that reaches the basin, by reducing the total amount of precipitation.

5.4 GROUND WATER QUALITY IMPACTS

Some of the activities mentioned in Section 4.2 could potentially also degrade groundwater found in surficial water-bearing units (primarily alluvium and the Pictures Cliffs Sandstone). Spills of fuels used during construction, while contained in berms, may infiltrate downward into ground water. In general, small spills of fuels or other construction-related liquids are likely to contaminate the soil in the immediate spill area only; a large spill would require some remedial action. Here again, it is crucial that construction crews are constantly reminded of the importance of limiting spill volumes and extents. Sewage produced during construction activities should be totally contained in contractor-provided chemical toilets, so as not to have any effect on ground water at the plant

site. Little or no effect on ground-water quality is expected from concrete-pouring activities, as cleaning operations would be done off-site.

Ground-water quality in surficial water bearing units (primarily alluvium and the Pictured Cliffs Sandstone) may be affected by a number of activities occurring during operation, both at the plant site and the mine site. Ground-water contamination could result from the storage of coal on-site and the collection and storage of runoff in the coal pile runoff pond, the storage and disposal of concentrated brines in evaporation ponds, and the disposal of plant solid wastes in the mine pits.

As noted in the Project Description Technical Report, runoff from coal piles would be collected in basins designed and constructed with the capacity to contain drainage resulting from the maximum 24-hour precipitation event that occurs once in 10 years. At the present time, it is expected that the pond would be lined to reduce percolation. A specific lining material has not yet been chosen. The foundation beneath coal piles would also be prepared to reduce infiltration. If necessary, a clay liner may be used to reduce infiltration from the coal pile area and to deliver more of the incoming precipitation to the lined evaporation ponds.

Coal-pile runoff from storage of high sulfur coal in relatively wet climates has been observed to cause pollution of both surface and ground waters. The contamination results from the intermittent contact of high sulfide-containing coal with sufficient moisture and oxygen, causing oxidation of metal sulfides to sulfates. These in turn produce sulfuric acid when combined with water. The sulfuric acid leaks into the pile, causing many of the chemicals in the coal to become soluble. The chemicals are then washed out of the coal by rain, producing a significantly polluted runoff. Consequently, coal-pile runoff from storage of high sulfur coal in relatively wet climates typically has a low pH and generally contains high concentrations of suspended solids, metallic elements (aluminum, chromium, manganese, and zinc), chlorides, sulfates, phosphorus, and ammonia. The quantity of these pollutants in runoff from coal-piles storing low sulfur coal is much less because of the smaller amount of sulfides in the coal. The differences in the quality of coal-pile runoff between low-sulfur Montana coal and higher-sulfur Illinois No. 6 coal have been recently demonstrated

by Davis and Boegly (1981). Parametric testing was used to determine the qualities of leachates resulting from different coals, crushed to different sizes, and under different conditions of moisture and oxygen availability; the results are listed in Table 5-12.

As Table 5-12 shows, the leachate from the Montana coal differs substantially from both the Illinois No. 6 coal. The sulfur and iron content values are: for Montana coal, 1.07 percent and 0.178 percent; for Illinois No. 6 coal, 4.62 percent and 1.49 percent; and for Bisti coal, 0.54 percent and 0.71 percent. Thus the runoff collected by the coal-pile runoff pond is likely to have characteristics similar to that of Montana coal leachate. Other tests on New Mexico coal have shown similar results; for example, Wachter and Blackwood (1978) performed leaching studies on a variety of U.S. coals to simulate the characteristics of coal-pile runoff. Their results for a New Mexico coal are listed in Table 5-13. As predicted by Davis and Bogly (1981), the levels of dissolved constituents are low, much lower than ambient ground water.

Because of the liner in the runoff pond, the rate of seepage through the liner to the underlying strata is expected to be slow. If a clay liner is chosen, it would provide a barrier for water movement, as well as act to retard the movement of certain pollutants to the underlying strata. Specifically, pollutants with net positive charges tend to be retarded because of the net negative surface charge of the clay particles. Pollutants with a net negative charge, such as several compounds of arsenic and selenium as well as some negatively charged organics, tend to be retarded much less. The same would be true of organics with a neutral charge. Because these compounds are likely to be found in coal-pile runoff, it is important to limit the net movement of seepage into the ground water from this pond.

As shown in a geotechnical report for the NMGS plant site (Sergent, Hauskins and Beckwith 1978) the coal-runoff pond would be located immediately adjacent to De-na-zin Wash. Review of the boring logs contained in that report shows that from 10 to almost 30 feet of silty sand overlies the Pictured Cliffs Sandstone. Based on these logs and the logs (Shomaker 1980) resulting from the PNM monitoring-well program, it would appear that seepage from the pond could move through the unsaturated silty sand layer to reach the less permeable underlying sandstones

Table 5-13. COAL STORAGE AREA
EFFLUENT CONCENTRATIONS

Water Quality Parameter[a]	Coal 131	Coal 133
pH, S.U.	6.7	6.5
Total Dissolved Solids	472	344
Total Suspended Solids	107.7	484
BOD_5	<20	<5
COD	1137	413
Total Organic Carbon	167.7	158
Iron	2.9	8.56
Manganese	0.07	0.06
Sulfate	275	133
Chloride		
Nitrate as N	0.14	0.30
Total Phosphate as P	ND	0.03
Free Silica	<0.05	2.08
Antimony	14	<0.0005
Arsenic	13.4	0.016
Beryllium	ND	ND
Cadmium	ND	ND
Chromium	ND	ND
Copper	0.05	0.12
Lead	0.085	0.045
Nickel	0.055	0.030
Selenium	46	<0.002
Silver	ND	ND
Zinc	0.135	0.205
Mercury	0.0023	0.0019
Thallium	ND	ND

Source: Wachter and Blackwood 1978.

ND = not determined.

[a]Units are mg/l unless otherwise noted.

and siltstones. The seepage could then move down into the De-na-zin Wash alluvium.

Once in the alluvium, the water would mix with alluvial waters and move downgradient approximately parallel to the direction of water movement in the surface drainage. The maximum rate of movement may be on the order of several feet per year. Shomaker (1980) estimates that the maximum rate of alluvial ground-water movement in the project area occurs in Alamo Wash and that the maximum rate would be about 3.3 feet per year. If the seepage rate wasn't large enough to substantially alter the ground-water gradient, the mixture of seepage and upgradient waters would tend to move downgradient at a rate similar to the existing flow rates. If the seepage was small, the net movement would be less than a few hundred feet during the expected 40-year life of project facilities.

The amount of seepage that might enter the alluvium cannot be accurately estimated at this time because an operational plan for the facility has not been developed; nor are data available on the size of the pond or its contributing area. However, if the chosen lining material effectively limits the seepage, the discussion above indicates that the net movement of seepage downgradient would be small. In general, the quality of coal pile runoff is expected to be better than that of alluvial groundwater. The concentrations of soluble organics and such trace elements as selenium and arsenic may be higher. While the concentrations of these compounds would increase, the increase would be limited to the area immediately downgradient from the pond. Further downgradient, the concentrations of these compounds would be reduced by dilution, attenuation, and degradation processes.

As noted previously, in Section 5.3.2, the New Mexico EID has regulations overseeing the discharge of wastewaters to the ground. These regulations require that a discharge plan be prepared by the applicant, describing the potential discharge sources and the characteristics of the underlying and downgradient hydrogeological environment. Such a discharge plan would have to be prepared for the coal-pile runoff pond. Although specific downgradient contamination cannot presently be predicted without greater design and operational data about the pond, review and approval of the discharge plan by the EID would

ensure that groundwater degradation would be minimal. The design and operational data required to review the coal-pile runoff pond discharge plan will be available by the time (1990) an approved discharge plan is required.

The other on-site wastewater storage facilities would be the evaporation ponds. The locations of the ponds are shown in Figure 2-1 of the Project Description Technical Report. The details of pond design and construction would be established in the project final design. Several ponds would be available to provide flexibility in system operation. The ponds would be lined with impervious material (probably compacted clay) to limit and control seepage losses. Water might be recovered by decanting from ponds receiving settleable sludges. Sufficient pond surface area would be provided to evaporate the water received in the ponds, on an annual basis, and sufficient depth would be provided in the ponds to accommodate surges resulting from storm runoff or accumulations during periods of low evaporation.

The hydrogeologic system beneath the proposed evaporation ponds is similar to that observed for the coal-pile runoff ponds in that seepage from the site, if any occurred, would eventually reach alluvial material in De-na-zin Wash. The net rate of movement of a mixture of alluvial waters and this seepage should be about the same as discussed previously for the case of the seepage from the coal-pile runoff ponds.

The quantity of water that would seep through the design containment system cannot be predicted at this time. Such a calculation would require detailed pond design and operation specifications (such as liner composition and thickness, exact waste characteristics, detail on the leachate collection system, types and depths of clay materials, etc.). Even if these specifications were available, the potential risk of failure of the pond seepage containment system would have to be considered. Potential liner failures can be grouped according to their underlying physical, biological, or chemical cause. Potential failure modes are listed and discussed in Table 5-14 (Matrecon 1980).

The many potential failure modes associated with liner systems require that considerable attention be given to their design, construction, and operation. The basis for such attention should be an operations and procedures manual

Table 5-14. POTENTIAL FAILURE MODES OF LINERS

Physical	Biological	Chemical
Puncture	Microbial attack	Ultraviolet attack
Tear		Ozone attack
Creep		Hydrolysis
Freeze-thaw cracking		Ionic species attack
Wet-dry cracking		Extraction
Differential settling		Ionic species incompatibility
Thermal stress		Solvents
Hydrostatic pressure		
Abrasion		

"Puncture failure would most commonly occur in membrane liners; however, such failure can occur in the other types of liners under specific circumstances. Puncture failure of membrane liners due to sharp angular rocks in the subgrade that have become exposed to the liner because soil fines migrated downward over time is a major concern. Puncture from operations, man or vehicular, is of concern but can largely be mitigated through good operation procedures. Burrowing animals and animals seeking water can also cause puncture.

"Tear failure is similar to puncture failure in its occurrence. Because of a membrane's relative thinness compared to soils, clays, asphalts and other liners, its resistance to failure in that dimension is correspondingly reduced. Localized structural tear failure can result from several stress-relaxation-stress cycles in which the liner is losing strength or it stretched with each cycle. Tear, like puncture, can occur due to operations or animals.

"Creep is the common term used to describe increasing deformation of a material under sustained load. The main factors which influence creep failure are material microstructure, stress level and temperature. The significance of this type of failure is that it is difficult to detect and control. Creep can occur with any liner material.

"Cycles of freezing and thawing cause material cracking which leads to failure by volume expansion of liquids in pore spaces during freezing. This expansion increases pore space volume and the accessibility of liquids to the pore space volumes. In addition, the freeze-thaw cycle will not be a localized failure at a facility, but will occur throughout. Proper planning and design is essential to mitigate this type of failure in areas where freezing is a major concern.

"This mode of failure is most commonly found when clay liners are used. The wet-dry cycles cause alternate expansion and shrinkage of clay liners which decrease the strength of the liner and increase its overall effective permeability. Because soil materials have poor tensile strength, the shrinkage caused by drying is highly disruptive to the cohesive structure of clays. Other liners are adversely affected by wet-dry cracking, but to a lesser extent.

Table 5-14. POTENTIAL FAILURE MODES OF LINERS (continued)

"Differential settling can damage all liners. This problem is best mitigated with a thorough geologic analysis prior to site selection and careful subgrade design and construction. Differential settling is a localized structural stress phenomenon and the greater the thickness and elasticity of the liner, the greater the tolerance range for differential settlement.

"Thermal stress results from differential temperatures through a material or when temperature change is sufficient to cause a phase change in a material. This temperature change (especially in polymeric membranes) can cause volume changes by thermal expansion (or contraction) as the case may be, or by phase changes. Thermal stress may also become significant in light of the different reaction rates produced by individual components of a composite material. Phase changes in solid materials caused by heat, generally cause stress because different phases usually have different volumes per unit weight. Thermal stress can be controlled or tolerated by allowing for expansion or contraction in design, stress relief, or an acceptable range of variation. However, if the stress is great enough, cracks will occur. All asphalt liners are highly susceptible to temperature. Polymeric membrane liners are also temperature sensitive, but to a lesser degree.

"Hydrostatic pressure is of concern when the structural support of a subgrade or base material is lost by piping, sinkholes, oxidation of organic material, settlement, etc.

"The continuous or near continuous action of abrasion on a liner has a significant wearing effect over time. Windborne abrasion is a serious consideration. In arid regions, sand particles carried by the wind have a sandblasting effect on the liner. Liners with high abrasion resistance must be specified, or a protective cover must be placed on the exposed berms. Runoff entering the pond from the surrounding topography may contain sticks, branches, rocks, and other debris which could abrade, tear, or even puncture the liner. Construction of a diversion channel to handle runoff will avoid the potential problems.

"The major emphasis on biologically induced failure is microbial attack in which the microbes "eat" the material and damage or destroy its structural integrity and low seepage characteristics. Particularly susceptible to biological attack are the plasticizers that are used in some polymer compounds. Bactericides are sometimes used to counteract this type of failure.

"The most serious chemical effect to polymeric liners at waste disposal facilities is that of swelling. Potentially, sufficient swelling can cause loss in strength, elongation, creep and flow, and loss in puncture resistance. Failures of these types are most apparent when the liner is in direct contact with the wastes.

"Liner materials such as polyvinyl chloride which contain large amounts of monomeric plasticizer are highly susceptible to extraction of the plasticizer. Such extraction can result in embrittlement and shrinkage and possibly breakage of the liner.

Table 5-14. POTENTIAL FAILURE MODES OF LINERS (concluded)

"Exposed polymeric linings can be subject to failure from heat and infrared, ultraviolet light, oxygen, ozone, and moisture. The factors generally operate in combination, with the presence of oxygen and moisture being the major contributing factors. Failure of the liner generally occurs from embrittlement, shrinkage and breakage. Ozone can cause cracking of many polymers, particularly those which contain some unsaturation. Failures of this type occur in areas where the rubber sheeting is stretched.

"Considerable information is available on the durability and service lives of exposed lining materials in which the principal environmental conditions are ultraviolet light, oxygen, ozone, heat, and wind."

Source: Matrecon 1980.

prepared by the design, construction, and operations team. The Suggested Mitigation section contains elements of this procedures manual. As noted above, review and approval of the discharge plan for this pond required by the New Mexico EID would ensure that ground-water quality degradation would be minimal.

Solid waste disposal activities might also affect ground-water quality. Specific plans for the disposal of municipal-type solid wastes generated by plant activities and of excess sewage sludge from the package sewage treatment plant have not yet been formulated. It is expected that their disposal would comply with applicable local, state, and federal regulations. If a sanitary landfill for disposal of these wastes were properly constructed and operated, water quality degradation would be limited to the soils immediately underlying these sites. New Mexico Solid Waste Management Regulations allow a property holder to dispose on his property of solid waste generated on his property as long as such disposal does not create a nuisance, a hazard to health or pollute any body of water.

Ash and scrubber-sludge solid wastes would be returned to the mine pits for disposal. As discussed in the Project Description, the proposed action would include combining fly ash with flue gas desulfurizer (FGD) sludge prior to disposal. This wet material would be hauled by end-dump trucks to previously mined portions of the coal mine. Disposal areas would be selected on the basis of: (1) providing substantial vertical separation between the disposed ash and ground water; and (2) proximity to the power plant. Disposal areas would be prepared for receiving ash by first backfilling with mine overburden to a depth of 20 to 60 feet, depending on the volume of overburden requiring disposal. The surface of the overburden would then be leveled and nominally compacted by the equipment used in the leveling operation.

Ash would be dumped and spread in the layers of maximum thickness for the trucks used. Present expectations are that several layers of ash would be spread, to an ultimate thickness of 40 to 60 feet. This would be covered with random overburden from mining operations to a depth of 4 to 8 feet. The overburden would in turn be covered with a layer of select overburden material to a depth of 8 inches. An 8-inch layer of surface soil or topsoil would

be spread, shaped, and gently sloped to prevent pooling of water at any location and to permit drainage without erosion. A vegetative cover would then be established to prevent erosion.

Potential water quality degradation resulting from these disposal activities could occur through a number of mechanisms: (1) poor-quality water initially found in these wastes could leach down into underlying water-bearing zones: (2) vertical infiltration of water through the cover, into the waste pile, and then into a water-bearing zone; (3) horizontal movement of ground water from adjacent water-bearing zones; and (4) upward movement of water under artesian pressure into the overburden and waste materials from the underlying Pictured Cliffs Sandstone.

In general, though, the mine site is an excellent location for high volume waste disposal. Both the area's climate and geology contribute to this situation. The low annual precipitation, high runoff, and the high evaporation rates in the area allow only a very small amount of water to infiltrate into underlying ground-water bearing zones (BLM 1976). Moreover, the generally fine-grained nature of the formations, the numerous, intermediate, impermeable layers of clays and shales, and the lack of fracture or other types of permeability severely limit the infiltration of water into and the transport of water through underlying water-bearing zones in the area (BLM 1976).

Before discussing these potential mechanisms for ground-water quality degradation, it is useful to review applicable federal and state regulations. The federal regulatory program on solid wastes resulted from the passage of the Resource Conservation and Recovery Act (RCRA) of 1976 and its subsequent amendments. RCRA is divided into several sections; Subtitle C is designed to control hazardous waste and Subtitle D is designed to control nonhazardous waste. However, there is no federal nonhazardous waste program; the states are responsible for implementing a nonhazardous waste program according to guidelines established by the federal government. The previously mentioned Solid Waste Management Regulations are New Mexico's version of Subtitle D guidelines.

According to Subtitle C regulations, there is a list of wastes that are automatically considered hazardous. Other wastes can be classified as hazardous if tests indicate that they possess any of the following characteristics: toxicity, corrosivity, ignitability, or reactivity. Specific criteria have been developed in order to determine if the waste actually possesses any of these characteristics.

To avoid the large economic burden to utilities (and subsequently to consumers) that regulation of these wastes as hazardous wastes would cause, Congress passed the Solid Waste Disposal Act Amendments of 1980. These amendments specifically exempt from the hazardous waste program fly ash, bottom ash, scrubber sludge, or any other material disposed of in conjunction with these wastes. State nonhazardous waste programs, consequently, are responsible for regulation of these wastes. In addition, Congress mandated the EPA to research the source and volume of utility waste, the current disposal practices, alternatives to these practices and the costs associated with both, the potential dangers of disposal and reuse, any damage cases associated with utility waste, the impact of various disposal alternatives on the use of natural resources, and the current and potential use of these waste streams. The EPA has begun that research through a contractor; it is expected that the research will be completed in 1983.

To estimate the effect of solid waste disposal on ground-water quality, one should consider the solid waste mixture requiring disposal. As shown in Table 2-5 of the Project Description Technical Report, fly ash accounts for about 70 percent of the mixture on a dry-weight basis. Bottom ash and coal refuse combine to form about 21 percent of the dry weight, and the dry mass of the scrubber sludge makes up the remaining 9 percent.

As discussed in the project description, the ash and scrubber sludge would react chemically to consume water in the mixture and to produce a material with a relatively low permeability. These reactions are expected because the chemical characteristics of the waste mixture are similar to those of Portland cement, the well-known agent used in concrete.

The major elements in Portland cement are calcium, aluminum, iron, silicon, and oxygen; minor elements include magnesium, sulfur, sodium, potassium,

and titanium. Typical compositions of Portland cement and several other cements are shown in Table 5-15. The waste mixture also contains these same elements; a possible composition is listed in Table 5-15. The estimate of the composition of the waste mixture assumes that the composition of bottom ash is similar to that of fly ash and that the quantity of coal refuse is small. Chemical characterizations (Rossof et al, 1979) of scrubber solids produced at existing plants have shown that scrubber solids are predominantly composed of calcium sulfate and calcium sulfate hemihydrate; smaller quantities of calcite are also present. A typical composition of scrubber solids might be about 40 percent by weight of calcium as calcium oxide and 50 percent by weight of sulfur as sulfur trioxide.

As shown in Table 5-15, the calcium content of the waste mixture is much less than that of the cements. This is important, as the calcium is needed in the hydration reactions. Typical reactions for these cements are as follows (Van Vlack 1967):

$$Ca_3\ Al_2\ O_6 + 6H_2O = Ca_3\ Al_2\ (OH)_{12}$$

$$Ca_2\ SiO_4 + xH_2O = Ca_2\ SiO_4 \cdot xH_2O$$

Obviously, more cementious material would be formed and more water incorporated if the calcium content was increased. Based on the available data, it cannot be predicted whether all the water in the waste mixture can be expected to chemically react to form cementious products. Specific testing would be required to make this determination. If the reaction does not proceed sufficiently, lime may be added to increase the calcium content. A conservative estimate is that some water will remain in the mixture. This water is not expected to move unless forced out of the pores due to downward infiltration of precipitation or lateral inflow from regional ground-water units.

However, the movement of water vertically or horizontally through the waste pile is expected to be negligible. The net amount of infiltration into the waste pile would be determined by the difference between the quantity of water provided by sources of water, (i.e., precipitation and possibly irrigation in reclaimed areas) and the quantity of water consumed by the sinks of water (i.e., runoff and evapotranspiration). Because precipitation in this area is quite

Table 5-15. CHEMICAL COMPOSITION OF PORTLAND CEMENT, HIGH ALUMINA CEMENT, SUPERSULFATED CEMENT, AND THE WASTE MIXTURE

Oxides of Chemical Elements	Portland Cement	High Alumina Cement	British High Sulfated Cement	Ashes[a]	Ashes and Scrubber Sludge[a]
CaO	64.1	37.7	45.2	3.8	7.2
Al_2O_3	5.5	38.5	13.0	27.4	24.8
SiO_2	22.0	5.3	24.4	56.8	51.4
Fe_2O_3	3.0	12.7	0.64	3.7	3.3
FeO	—	3.9	—	—	—
MgO	1.4	0.1	3.3	0.9	0.8
SO_3	2.1	0.1	7.6	1.9	6.4
Na_2O	—	—	0.5	2.1	1.9
K_2O	—	—	0.8	0.8	0.7
TiO_2	—	—	0.57	0.8	0.7
P_2O_5	—	—	—	0.1	0.1
MnO_2	—	—	0.75	—	—
S (Sulfides)	—	—	1.07	—	—

Source: Radian Corp. 1980.

[a]PNM data.

low. little or no infiltration due to precipitation is expected (Mann 1976). It is assumed that irrigation operations, if any are needed, would be designed to satisfy vegetative evapotranspiration requirements only.

As mentioned previously, the coal deposits are located in the outcrop region of the Fruitland Formation. As discussed in the Hydrology Technical Report, the formation consists of lenticular beds of mudstone, siltstone, silty sandstone, sandstone, and coal. Although it may yield small quantities of water to wells in localized areas, it generally acts as a confining layer on the Pictured Cliffs Sandstone. The location of the coal mine in the Fruitland Formation outcrop area serves to further limit the total quantity of water that might flow into the reclaimed mine pit from adjacent areas.

It is also possible that if an artesian head exists in a nearby saturated zone of the underlying Pictured Cliffs Sandstone, water from this formation could move upward into the altered overburden and then into the waste layers. While this possibility exists, the retarding effect of interbedded clay and shale layers and the limited availability of water due to the low infiltration rate suggest that upward movement of water into the waste would not be a problem.

Although movement of contaminated leachate away from the mine pits would not be expected, a monitoring program should be designed to detect potential leachate production and movement. If leachate production and subsequent movement is detected, remedial measures can be implemented to reduce or eliminate the problem.

6.0 WATER SUPPLY PIPELINE

Potential water quality impacts resulting from the construction and operation of the water supply pipeline may affect surface- or ground-water quality along the pipeline route. Surface-water impacts may result from increased erosion from disturbed areas, crossing of streams, and discharge of hydrostatic test fluids and other waste solutions produced during construction. Degradation of ground-water quality may result from the discharge and subsequent infiltration of hydrostatic test fluids or other construction-related waste solutions into near-surface aquifers.

6.1 BASELINE WATER QUALITY

The water quality of streams near the pipeline route is probably very similar to that observed near the plant site and described in Section 5.1. Of particular importance to the potential impacts of the proposed pipeline are the very high levels of suspended sediment that are routinely observed in these ephemeral channels during flow conditions. At the proposed plant site, suspended sediment concentrations have ranged up to 626,000 mg/l and averaged about 57,000 mg/l for selected tributaries to the Chaco River.

The quality of the near-surface ground waters over which the proposed pipeline would pass is highly variable, as noted in Section 4.1 and Table 4-1. The pipeline would cross alluvium, the Kirtland Shale and Fruitland Formation, the Ojo Alamo Sandstone, the Nacimiento Formation, the Pictured Cliffs Sandstone, and possibly the Lewis Shale. The potential range in the water quality of these units is listed in Table 4-1.

6.2 WATER QUALITY IMPACTS

6.2.1 Construction

Construction of the water supply pipeline is likely to have little effect on either surface- or ground-water quality. Little effect is expected because of the nature of pipeline construction, the generally arid environment and the construction procedures proposed by PNM. Construction procedures that would limit downstream effects include:

1) Construction of new access roads would not be required.
2) Watercourses would not be crossed during periods in which high flow is known to occur (e.g. late summer).
3) Construction activities at stream crossings would be with completed within 14 days.
4) During construction at stream crossings, drainage or storm runoff from staging areas would be controlled via detention basins, evaporation pits, or straw bale filters to limit suspended solids and oil or grease input into streams.
5) Stream gradients and stream banks would be restored and breakers or riprap would be placed where erosion control is warranted.
6) Erosion control, as necessary, would be employed on staging areas (greater than 4 percent slope) along the main water pipeline ROW and along any cuts through unconsolidated materials.

In general, all reasonable procedures would be taken to control erosion and soil damage resulting from construction, rehabilitation, operation and maintenance. As mentioned in Section 4.2.1, any spills of construction materials and solutions would be small in quantity and localized in extent. Proper consideration by the construction crew would greatly reduce spill frequency and duration. While increased soil loss and some resulting increases in suspended sediment concentrations would occur, the extremely large suspended sediment concentrations presently observed (when flow in these streams occurs) would make the construction-induced increase negligible.

Again, because the suspended sediment concentrations in surface waters are already high, stream crossings are expected to have little or no effect on such concentrations. As mentioned in Section 4.2.1, U.S. Army Corps of Engineers' permits under the Section 404 program of the Federal Water Pollution Control Act of 1972 are automatically granted to utility crossings of waters of the United States if the construction and operation of the crossings meet certain criteria. In this case, the ephemeral channels crossed by the pipeline are not even classified by the COE as waters of the United States. Even though COE permits would probably be automatically granted, construction activities would follow COE requirements for utility-line crossings. As with other pipeline facilities, construction of the water supply reservoir would have little or no effect on the suspended sediment concentrations of area waters.

Discharge of hydrostatic testing waters would have little or no effect on either surface- or ground-water quality along the construction route. At present, no specific plans have been formulated, although it is expected that their discharge would meet all applicable local, state, and federal regulations. As discussed in Section 3.2.1, an NPDES permit would have to be obtained in order to discharge to surface waters. Basic information required for this permit includes the quantity, quality, and location of the discharge. The quality of the discharge would depend primarily on the quality of the input water.

6.2.2 Operation

Operation of the water supply pipeline and reservoir system would have little or no effect on either surface- or ground-water quality along the pipeline route or at the water supply reservoir. Spills or leaks from the pipeline are likely to improve surface- or ground-water quality becaue of the high quality of San Juan River water. Leaks or even rupture of the water supply reservoir would also improve downstream surface- and ground-water quality as long as the reservoir contained San Juan River water. If the reservoir contained a mixture of San Juan River water and ground water from the Westwater Canyon aquifer, release of this water to the environment could degrade local surface- or ground-water bodies. In general, the quality of ambient surface waters

would be better than that found in the reservoir if about half the water in the reservoir were to be obtained from the well field. Selected downstream wells in the alluvium have also been observed to have lower TDS levels. However, substantial leakage from the facility is unlikely, as present plans call for the control of seepage from the reservoir. Although the exact method for such control has not been determined, potential alternatives include the use of natural material already in place or the placement of a relatively impermeable material (e.g. clay or plastic liner) along the reservoir floor and walls. The potential operational effects of the water supply withdrawal on the San Juan River are discussed in Section 3.5.2.

6.2.3 Alternative Routes

From a water quality standpoint, very little difference exists between the pipeline alternatives. Little difference exists because the potential water quality impacts associated with pipeline construction in a semi-arid environment are small. The very high suspended solids content in existing ephemeral channels when they do flow limits the relative impact of soil losses from small disturbed areas. The linear character of pipelines spreads these small suspended sediment increases over a larger number of channels so that the disturbance per channel is essentially imperceptible. In addition, hydrostatic testing has little or no effect on water quality. Spills occurring during operation might have a beneficial impact on surface and/or ground-water quality.

While the impacts on water quality would be negligible, basic differences between the pipeline routes can be discerned. First, different pipeline routes disturb different amounts of land. Route P2 disturbs slightly more land than the first alternative (P1), and route P3 disturbs the greatest amount of land. In terms of terrain, routes P1 and P2 are similar, while route P3 has an area of very steep terrain. The intensity and duration of impacts of the alternative water supply reservoir would be similar to those of the proposed reservoir.

7.0

TRANSMISSION LINES

7.1 BASELINE WATER QUALITY

The water quality of selected streams or lakes traversed by or adjacent to the transmission line routes is listed in Table 7-1. Surface-water quality along the transmission line routes is quite variable, with observed specific conductance of selected stations ranging from 102 to 6700 μmhos/cm and averaging about 1200 μmhos/cm over these stations. Sodium is the dominant cation; bicarbonate and sulfate are the dominant anions. The predominance of either sulfate or bicarbonate appears to be dependent on the TDS content of the water. Low-TDS waters (less than 750 mg/l TDS) appear to be bicarbonate-dominated; for the higher-TDS waters, sulfate is the dominant anion. The high levels of total iron and trace elements are due to the high suspended sediment concentrations found in the water.

The proposed transmission lines (T1 and T2) pass over a number of different geologic strata. These materials include alluvium, the Santa Fe Group, the Nacimiento Formation, Ojo Alamo Sandstone, Fruitland Formation, Pictured Cliffs Sandstone, Lewis Shale, Cliff House Sandstone, Menefee Formation, Point Lookout Sandstone, Mancos Shale, and Gallup Sandstone. The ranges of possible water qualities of these formations are listed in Table 4-1. Tremendous ranges between observations from any individual aquifer as well as between measurements of different aquifers have been noted.

7.2 WATER QUALITY IMPACTS

7.2.1 Construction

Construction of the transmission line is expected to have very little effect on either surface- and/or ground-water quality. Little effect is expected because of the nature of transmission line construction, the generally arid environment

Table 7-1. SURFACE-WATER QUALITY ALONG THE TRANSMISSION LINE ROUTES

Water Quality Parameters	Kim-Me-Mi-Oli Wash 35°50'6" 108°3'17"	Chaco Wash Near Starlake Trading Post 35°56'07" 107°31'39"	Kim-me-mi-oli Wash 35°58'41" 108°8'18"	Chaco Wash at Chaco National Canyon 36°01'43" 107°55'04"	Gallo Wash at Chaco N.M. 36°02'6" 107°53'25"
General Constituents					
Flow, cfs	---	---	---	---	36(2.6-100) 10
Dates	4/22/81	11/7/77-3/4/81	3/27/78-4/22/81	8/6/76-2/25/80	1/18/79-8/17/79
Water Temperature (°C)	-------	13.2(1-22) 10[a]	19.5(18.5-20.5) 2	9.5(0-29) 534	2(0-4)
pH	9.3(1)	7.6(7-8.8) 51	8(7.4-9.0) 7	7.5(6.3-8.5) 101	7.8(7.1-8.3) 10
Specific Conductance[b]	2070(1)	619(102-6700) 51	1510(500-3000) 7	467(185-900) 103	432(255-800) 10
Total Dissolved Solids	1250(1)	240(165-366) 6	1855(1370-2340) 2	356(190-550) 5	185(1)
Suspended Solids		13640(706-26100)	7430(511-16900)	29480(395-131000) 582	2570(1510-4230) 10
Turbidity, JTU				16070(2200-36000) 3	-------
Alkalinity as $CaCO_3$	240(1)	103(71-180) 8	310(213-390) 4	171(74-427) 54	75(1)
Hardness as $CaCO_3$	35(1)	16(11-21) 6	48.5(38-59) 2	68.2(20-160)	47(1)
Dissolved Oxygen		8.6(6.3-10.8) 6			11.6(1)
Organic Carbon					31(14-40) 8
Total N, as N				14.8(2-46) 14	1.8(1)
Total P, as P				2(0.09-5.2) 13	.63(1)
Common Ions					
Calcium	12(1)	5.8(4.2-7.8) 6	16.5(13-20) 2	23.2(6.8-55) 31	16(1)
Magnesium	1.2(1)	.43(.1-.7) 6	1.8(1.3-2.3) 2	2.4(0.7-6.8) 31	1.7(1)
Sodium	450(1)	66.7(44-100) 6	605(460-750) 2	83.4(37-150) 31	43(1)
Potassium	2.5(1)	2.0(1.5-2.6) 6	5.8(3.4-8.6) 7	4(2.2-14) 35	6.6(1)
Bicarbonate	220(1)	123(86-220) 8	365(260-480) 4	214(90-520) 46	92(1)
Sulfate	550(1)	71.2(4.7-130)	905(610-1200) 2	65(30-140) 32	56(1)
Chloride	75(1)	12.9(3.6-57) 6	70.5(57-84) 2	7(2-21) 32	7.8(1)
Silica	15(1)	10(4.7-16) 6	32(13-51) 2	11.2(4-16.1) 32	8.3(1)
Fluoride	1.4(1)	0.4(0.3-0.6) 6	1.7(1.5-1.9) 2	0.7(0.3-1.1) 32	.2(1)
Boron	0.17(1)	.09(.04-.26) 6	.29(.19-.38) 2	.192(.070-.550)/.078(.040-.300)	.24(1)/.08(1)
Iron					27(1)/.04(1)
Trace Elements (µg/l)					
Arsenic	3(1)/2(1)	25(1-69) 46/1.2(1-2) 4[c]	---	96(3-1200) 65/2.5(0-7) 37	7(4-14) 8/4(1)
Barium	---	---	---	---	-------
Cadmium	1(1)/1(1)	1.3(1-2) 3/.8(0-1) 4	---	6.8(0-20) 26/.8(0-3) 14	-------
Chromium	0(1)/0(1)	60(60) 3/5(0-10) 4	---	134(0-310) 28/6(0) 16	-------
Copper	8(1)/8(1)	273(240-320)/25(11-40)	---	270(10-880) 13/8(1-25) 11	-------
Lead		145(95-180)/14(0-38)	---	410(0-1800) 66/6.5(0-87) 40	0(1)
Mercury	0(1)/0(1)		---	1(0-19) 19/0.02(0-0.2) 13	.2(.1-.4) 7
Nickel		59(26-90)/4.5(3-7)	---	160(1)	-------
Selenium	3(1)	3.1(0-12) 46	---	4.6(0-37) 29/1.2(0-4) 13	1.1(1-2) 7
Zinc				655(100-1400) 11/15(0-40) 11	-------

Source: EPA STORET retrieval 1981.
Note: All units mg/l unless otherwise noted.

[a] Mean (range) number of measurements.

[b] (µmhos/cm)

[c] Total/dissolved.

Table 7-1. SURFACE-WATER QUALITY ALONG THE TRANSMISSION LINE ROUTES (continued)

Water Quality Parameters	Juan Lake 36°5'34" 108°9'38"	Escavedo Wash 36°6'14" 107°57'20"	Ah-shi-sle-pah Wash 36°9'18" 107°56'47"	San Lucas Creek 35°21'06" 107°35'34"
General Constituents				
Flow, cfs	———	170(0-500) 9	182(0.01-1000) 108	———
Dates	4/22/81	2/17/77-9/11/80	2/8/78-3/16/81	6/30/70
Water Temperature (°C)	———	7.3(2.5-12) 5	8.9(.5-13) 17	11(1)
pH	8.5(1)	8(6.9-8.6) 7	7.6(6.9-8.5) 58	8.3(1)
Specific Conductance[b]	2940(1)	670(440-1000) 7	833(280-2600) 58	———
Total Dissolved Solids	1800(1)	367(293-440) 2	442(310-581) 4	100(1)
Suspended Solids	———	21450(8600-30900) 4	53500(6000-220000) 98	———
Turbidity, JTU	———	7900(1)	———	60(1)
Alkalinity as $CaCO_3$	415(1)	260(170-340) 6	183(88-368) 34	90(1)
Hardness as $CaCO_3$	82(1)	17(6-25) 3	24.4(9-47) 5	130(1)
Dissolved Oxygen	———	———	———	9.5(1)
Organic Carbon	———	60(50-77) 3/4.2(2.6-5.8) 2	231(3.8-561) 23/7.3(4.5-13) 7	———
Total N, as N	———	16(12-20) 2	12.3(8.7-16) 3	———
Total P, as P	———	1.2(.68-1.7) 2	2(.58-3.4) 5	———
Common Ions				
Calcium	25(1)	6.2(2.3-9) 3	8.4(2.6-17) 5	15.3(1)
Magnesium	4.8(1)	.4(.1-.5) 3	.8(.6-1) 5	———
Sodium	610(1)	128(93-150) 3	136(98-180) 5	———
Potassium	5.7(1)	1.7(1.2-2) 3	4.2(3-7.5) 5	———
Bicarbonate	490(1)	350(230-410) 4	231(88-368) 31	———
Sulfate	760(1)	98(54-130) 3	184(100-250) 5	0.0(1)
Chloride	120(1)	3.1(2.1-3.9) 3	23(7.1-53) 5	2.5(1)
Silica	12(1)	15(13-18) 3	16(11-19) 5	———
Fluoride	2.1(1)	.9(.7-1.3) 3	.5(.3-.6) 5	———
Boron	.25(1) (Dissolved)	.18(.17-.19) 2/.11(2)	.24(.08-.57) 33/.17(10)	———
Iron	.28(1) (Dissolved)	328(320-330) 4/.52(.05-1.3) 4	286(69-540) 30/.5(8)	———
Trace Elements (µg/l)				
Arsenic	———	64(35-90) 4/13(7-20) 4	83(4-670) 44/1.5(0-3) 10	———
Barium	———	5700(5200-6400) 4/60(5)	3430(400-8300) 30/120(0-300) 9	———
Cadmium	———	16(2-30) 2/1(0-2) 2	12(0-45) 9/1(4)	———
Chromium	———	125(90-150) 2/5(0-10) 2	77(60-120) 6/10(0-20) 6	0.0(1)
Copper	———	———	390(340-440) 2/16(15-21) 2	0.0(1)
Lead	———	770(600-900) 3/.7(0-2) 3	640(0-1400) 35/8.4(0-28) 8	———
Mercury	———	.65(.5-.8) 2	1.5(.4-3) 15/.1(0-.6) 7	———
Nickel	———	———	81(78-84) 2/3(2-4) 2	———
Selenium	1(1)	0(1)/3(1)	7.4(1-18) 16/1.7(0-5) 6	———
Zinc	———	———	385(770-1000) 2/69(66-72) 2	———

Table 7-1. SURFACE-WATER QUALITY ALONG THE TRANSMISSION LINE ROUTES (concluded)

Water Quality Parameters	Arroyo Chico near Guadalupe 35°35'33" 107°11'19"	Papers Wash Near Starlake Trading Post 35°53'36" 107°24'58"
General Constituents		
Flow, cfs	———	———
Dates	4/13/78-2/5/81	3/1/79-2/21/80
Water Temperature (°C)	11.9(0.0-24) 19	3(0.0-6) 2
pH	8.8(1)	7.8(7.2-8.9) 19
Specific Conductance[b]	2120(146-5270) 32	299(193-414) 19
Total Dissolved Solids	2380(1)	180(136-224) 2
Suspended Solids	36160(54-29300) 32	6350(566-19800) 19
Turbidity, JTU	37(1)	———
Alkalinity as $CaCO_3$	340(1)	140(110-170) 2
Hardness as $CaCO_3$	170(1)	35(33-37) 2
Dissolved Oxygen	———	10.2(9.3-11.1) 2
Organic Carbon	———	———
Total N, as N	0.74(1)	4.3(2.4-6.2) 2
Total P, as P	0.06(1)	.55(.32-.77) 2
Common Ions		
Calcium	50(1)	12(11-13) 2
Magnesium	11(1)	1.15(1-1.3) 2
Sodium	750(1)	57(39-75) 2
Potassium	3.9(1)	3.3(2.9-3.7) 2
Bicarbonate	382(1)	165(130-200) 2
Sulfate	1300(1)	6.3(3.1-9.5) 2
Chloride	54(1)	8.2(4.3-12) 2
Silica	4.7(1)	8.1(6.4-9.7) 2
Fluoride	1.1(1)	.55(.5-.6) 2
Boron	0.21(1)	.075(.07-.08) 2
Iron		
Trace Elements (µg/l)		
Arsenic	4(1)/2(1)	13.5(1-38) 17
Barium	———	———
Cadmium	2(1)/0(1)	———
Chromium	0(1)/0(1)	———
Copper	7(1)/1(1)	———
Lead	11(1)/3(1)	———
Mercury	0(1)/0(1)	.26(0.-0.7) 17
Nickel	———	———
Selenium	0(1)/0(1)	———
Zinc	40(1)/10(1)	———

and the construction procedures proposed by PNM. Construction procedures that would limit downstream effect include:

1) Construction activities at stream crossings would be planned and supervised by the construction contractor and PNM engineering staff on a site-by-site basis to insure minimal introduction of sediments and contaminants to stream channels.
2) The extent of grading or clearing would be minimal. Clearing crews would make a minimal number of passes through the right-of-way, and would make use of existing access roads as much as possible.
3) Existing cleared areas would be used whenever possible for construction areas, storage areas, etc.
4) Grading and removal of grass cover or low growth would be prohibited unless considered necessary.
5) The application of herbicides would be prohibited along the right-of-way.
6) Where necessary, roadside drainage ditches and water bars would be installed along access roads.
7) All waste and scrap materials would be removed from the right-of-way and deposited in local landfills in compliance with local regulations and in accordance with land management agency or land owner agreements.
8) Temporary bridges and culverts would be removed from temporary access roads, and the roads repaired to their natural state by grading original slopes and planting natural cover.

As with other construction activities, some spillage of construction liquids as well as increased erosion along the selected transmission routes would be expected. Spills of construction liquids would usually be small in quantity and localized in extent. Consequently, such occurrences are not expected to be a problem along the route, especially if appropriate care is routinely applied to the handling and disposal of construction liquids (see Suggested Mitigation). The suspended sediment concentrations in area surface waters are already so high that the increased material lost from the construction sites would have

little or no effect on the sediment load of area streams. These same comments apply to the construction activities at Rio Puerco substation.

7.2.2 Operation

Operation of the transmission line facilities would have little or no effect on ambient surface- or ground-water quality.

7.2.3 Alternatives

The potential effects of the transmission line alternatives would be similar to those for the proposed routes. In all cases, water quality effects would be negligible. Alternative route T4, because of its steeper terrain and greater area of disturbance, could be considered to cause, at least theoretically, slightly greater effects.

8.0

SUGGESTED MITIGATION

The following section contains suggested mitigation measures which should be considered for implementation during either the design, construction or operational phases of the project.

Management of Spills at Construction Sites

1. Only the recommended amounts of materials should be used and they should be applied in the recommended manner.

2. Good housekeeping procedures such as proper disposal of empty containers, prompt cleanup of accidental spills, neutralization and deactivation of excess chemicals and wash water should be followed.

3. Oil and oily wastes such as crankcase oil, cans, rags, and paper dropped in oils and lubricants should be disposed of in proper receptacles.

4. Construction vehicles should be properly maintained to control petroleum leaks.

5. Movement of contaminated sediments should be controlled by appropriate sediment control measures such as surface roughening, interception and diversion, vegetative stabilization non-vegetative stabilization (mulches, netting, chemical binders, and sediment traps and basins.

Management of Hydrostatic Test Water

1. Whenever possible, hydrostatic test water should be disposed of on land, via evaporation pits or basins, with no surface-water discharge.

2. Water should be discharged horizontally into discharge diffuser pipe to minimize flow velocity and prevent potential scour effects.

3. If grease and oil are present, water should be routed through one or more straw bale filters, in sequence, to reduce concentrations to acceptable levels.

Management of Drilling Mud Disposal

1. Drilling mud should be disposed of in reserve pits, allowed to evaporate to dryness, and then backfilled and recontoured as necessary.

2. Reserve pits should be located in impervious strata or lined with impermeable materials.

3. Drilling muds should not contain toxic and hazardous materials. Typical recommended components include bentonite, polymer clay extender, hydrated lime, organic polymers, chrome-free lignosulfonates, lignites, caustic soda, barite, salt, zinc chloride, and soda ash.

Monitoring Plan for Surface-Water Discharges

1. All effluent discharge pipes should be equipped with continuous flow monitoring devices.

2. All effluent discharge pipes should be equipped with devices able to continuously monitor for, at least, pH and specific conductance.

3. All continuous monitoring devices on the discharge pipes should be connected to the central computer facilities for display, storage, and processing.

4. Automated samplers should be used to collect grab samples for composite analysis of effluent discharges.

5. Composite samples should be analyzed for the pollutants listed in the NSPS (including total suspended solids, oil and grease, total copper, and total iron). Other chemical parameters which should be measured in

the composite samples include TDS, the common ions (calcium, magnesium, sodium, potassium, chloride, sulfate, carbonate and bicarbonate), phosphorus and nitrogen species, as well as the 129 priority pollutants.

6. If discharges occur, water from downstream alluvial wells should be analyzed for the same parameters that were listed in 5 above.

7. A discharge plan describing the quantity and quality of surface-water discharges and of the existing downstream surface-water and hydrogeological environment will be submitted to the EID for review and approval before the power plant becomes operational. EID approval of the discharge plan would ensure that downgradient ground-water contamination would be minimal.

Management of Evaporation Ponds

As mentioned in Section 5.4, an operations and procedures manual needs to be prepared by the design, construction, and operations team to insure that the evaporation ponds perform as designed. Detailed information regarding all components of the liner system should be available to the operating personnel. This data should include:

1. Information on the characteristics, limitations, and performance of the liner should be obtained from the supplier and manufacturer, the designer, and the installer.

2. Samples of the liner material should be retained for possible use in case of malfunctioning of the impoundment.

3. Materials that might be harmful to the liner must be identified and deviations from the anticipated waste composition should be avoided.

4. Adequate records of the contents of the ponds must be maintained; periodic sampling of these waters is necessary.

Special monitoring procedures should be developed to assess whether the liner system is operating within the design criteria. Specifically, the quality of collected leachate, if any, and the condition of the liner should be regularly determined and recorded. Embankments and berms should be examined for potential ground movements, cracks, and soil erosion. Plans to control vegetation and rodents should be included in the operations and procedures manual. In addition to these concerns, the unacceptable nature of certain operational practices should be identified. These unacceptable practices include:

1. The discharge of high-temperature liquids onto exposed or unprotected liners (liners with no soil cover or with insufficient standing liquid levels).

2. The passage of any vehicle over any portion of an exposed liner.

3. The discharge of incompatible wastes to the liner.

4. The direct discharge of wastes with high hydraulic energy upon a liner without adequate provision for energy dissipation.

5. Unauthorized modifications or repairs to the facilities.

In addition to monitoring of the actual physical facilities, a monitoring network for downgradient groundwaters should be established. This network would include new wells and existing wells. The monitoring system should also include a leak detection system beneath the pond so that remedial actions, if necessary, could be taken in a timely manner before downgradient ground water is contaminated. Again, EID approval of the discharge plan for the evaporation and coal-pile runoff ponds would ensure that downgradient ground-water contamination would be minimal.

9.0

UNAVOIDABLE ADVERSE IMPACTS

- Construction of project facilities would result in unavoidable, short-term, increases in the suspended solids content and turbidity levels of water in stream channels immediately adjacent to construction activities.

- Spills of solvents, fuels and other construction-related fluids would result in unavoidable, short-term, contamination of water and suspended material in stream channels immediately adjacent to construction activities.

- Withdrawal of up to 35,000 ac. ft. of water from the San Juan River would result in an unavoidable increase (up to 4 mg/l at Imperial Dam) in the TDS content of water in the lower Colorado River System.

- Operational activities at the plant site, such as runoff and wastewater storage and evaporation ponds, solid waste disposal sites, and the unplanned release of plant wastewaters, would have an unavoidable effect on the quality of unconfined groundwaters in the immediate vicinity of the plant site.

10.0

RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Operational activities at the plant site, such as runoff and waste water storage and evaporation ponds, solid waste disposal sites and unplanned discharge of plant waste waters would have a long-term effect on the quality of unconfined ground waters in the immediate vicinity of the plant site.

POSSIBLE NEW TOWN

1.0
AFFECTED ENVIRONMENT

The possible new town site would be located in the drainage basin of De-na-zin Wash. The quality of water in these intermittent streams is likely to be similar to that found in De-na-zin tributaries near the proposed NMGS plant site. Levels of total dissolved solids (TDS) probably range from less than 500 mg/l to over 2000 mg/l; suspended solids concentrations are expected to be high. Total metal concentrations are high, with most of the metals being associated with particulate matter. The quality of ground water found in sandstone beds in the Fruitland Formation or Pictured Cliffs Sandstone are also expected to be similar to that found near the proposed NMGS plant site. The water from these formations is generally not suitable, without treatment, for municipal water supply or irrigation uses. Water quality criteria for stock watering use would also tend to be exceeded.

2.0

ENVIRONMENTAL CONSEQUENCES

Construction and operation of the possible new town could potentially affect both surface- and ground-water quality. Sediment loss during construction could increase the level of suspended solids and turbidity in downstream waters. Spills of solvents, detergents, concrete and other construction-related fluids would be expected to slightly contaminate water and suspended materials in affected stream channels. Usable ground-water supplies are not expected to be affected by such activities.

Disposal of municipal solid waste produced by possible new town could degrade ground-water quality. However, because of the arid conditions in the area, only ground-water aquifers in the immediate area of the landfill site could be degraded. Urban runoff could contribute suspended solids, nutrients, trace metals, and pesticides to downstream areas. Disposal of treated municipal sewage could affect downstream surface- and ground-water quality depending on the treatment/disposal option chosen. For example, surface-water discharge of treated effluent could (depending on the level of treatment) increase the levels of nutrients, pathogenic organisms, and refractory organics in downstream surface and ground waters. If an option like evaporation/percolation ponds was chosen, ground water in and down gradient of the percolation pond could be degraded.

Appendix A

NEW MEXICO WATER QUALITY STANDARDS

1-101. ANTIDEGRADATION POLICY

Degradation of waters the quality of which is better than the stream standards established by the New Mexico Water Quality Control Commission is not reasonable degradation and is subject to abatement under the authority granted the Commission by the New Mexico Water Quality Act, as amended, unless it is justifiable as a result of necessary economic and social development. Existing instream water uses shall be maintained and protected. No degradation shall be allowed in high quality waters of designated national and state parks and wildlife refuges if such degradation would impair any of the qualities which caused designation of the parks and wildlife refuges. To protect the existing quality of water, the Commission under that Act will require the highest and best degree of effluent treatment practicable. In those cases where potential water quality impairment associated with a thermal discharge is involved, this antidegradation policy shall be consistent with Section 316 of the Federal Clean Water Act. In implementing this section, the Commission through the appropriate regional offices of the Federal Environmental Protection Agency will keep the Administrator advised and provided with such information concerning the waters of New Mexico as he will need to discharge his responsibilities under the Federal Clean Water Act.

1-102. GENERAL STANDARDS

The following general standards apply at all times (unless otherwise specified in Part 2) to all surface waters of the State which are suitable for recreation and support of desirable aquatic life presently common in New Mexico waters:

A. Stream Bottom Deposits: The stream shall be free of water contaminants from other than natural causes that will settle and adversely inhibit the growth of normal flora and fauna or significantly alter the physical or chemical properties of the bottom. Siltation resulting from the reasonable operation of irrigation and flood control facilities is not subject to these standards.

B. Floating Solids, Oil and Grease: Receiving water shall be free of objectionable oils, scum, grease and other floating materials resulting from other than natural causes.

C. Color: Color-producing materials resulting from other than natural causes shall not create an esthetically undesirable condition nor should color impair the use of the water by desirable aquatic life presently common in New Mexico waters.

D. Odor and Taste of Fish: Water contaminants from other than natural causes shall be limited to concentrations that will not impart unpalatable flavor to fish, or result in offensive odor arising from the stream or otherwise interfere with the reasonable use of the water.

E. Plant Nutrients: Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in a dominance of nuisance species in receiving waters.

F. Hazardous Substances: Toxic substances such as, but not limited to, pesticides, herbicides, heavy metals, and organics, shall not be present

in receiving waters in concentrations which will change the ecology of receiving waters to an extent detrimental to man or other organisms of direct or indirect commercial, recreational, or esthetic value. Toxicities of substances in receiving waters will be determined by appropriate bioassay techniques, or other acceptable means, for the particular form of aquatic life which is to be preserved with the concentrations of toxic materials not to exceed 5% of the 96-hour LC-50 provided that: toxic substances which, through uptake in the aquatic food chain and/or storage in plant and animal tissues, can be magnified to levels which are toxic to man or other organisms, shall not be present in concentrations which result in this biological magnification. Waters used for domestic water supplies shall not contain hazardous substances in concentrations that exceed drinking water standards set forth in Section 202B of the New Mexico Regulations Governing Water Supplies.

G. Radioactivity: The radioactivity of surface waters shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in Part 4 of New Mexico Environmental Improvement Board Radiation Protection Regulations, adopted April 18, 1980.

H. Pathogens: The stream shall be virtually free of pathogens. In particular, waters used for irrigation of table crops such as lettuce shall be virtually free of Salmonella and Shigella species.

I. Temperature: Maximum temperatures for each stream reach have been specified in Part 2 of these standards. However, the introduction of heat by other than natural causes shall not increase the temperature, as measured from above the point of introduction, by more than 2.7°C (5°F) in a stream, or more than 1.7°C (3°F) in a lake or reservoir. In no case will the introduction of heat be permitted when the maximum temperature specified for the reach [generally 20°C (68°F) for cold water fisheries and 32.2°C (90°F) for warm water fisheries] would thereby be exceeded. These temperature standards shall not apply to impoundments constructed offstream for the purpose of heat disposal. High water temperatures caused by unusually high ambient air temperatures or the reasonable operation of irrigation and aquacultural facilities are not violations of these standards.

J. Turbidity: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that desirable aquatic life presently common in New Mexico waters is inhibited or that will cause substantial visible contrast with the natural appearance of the water. Turbidity attributable to natural causes or the reasonable operation of irrigation and flood control facilities is not subject to these standards.

K. Salinity: Where existing information is sufficient, numerical standards for total dissolved solids (or conductivity), chlorides and sulfates, have been adopted in Part 2 of these standards.

1. For the tributaries of the Colorado River system, the State of New Mexico will cooperate with the Colorado River Basin States and the Federal Government to support and implement the salinity policy and program outlined in the report "Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System" dated August 1978, and the supplement thereto dated December 18, 1978.

2. Numeric criteria for salinity are established at three points in the Colorado River Basin as follows: below Hoover Dam, 723 mg/l; below Parker Dam, 757 mg/l; and at Imperial Dam, 879 mg/l.

3. As a part of the program, objectives for New Mexico shall include the elimination of discharges of water containing solids in solution as a result of the use of water to control or convey fly ash from coal-fired electric generators, wherever practicable.

4. In determining compliance with the numeric criteria hereby adopted, salinity (TDS) is determined by the "calculation method" (sum of constituents) as described in the latest edition of "Techniques of Water-Resources Investigations of the United States Geological Survey - Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases".

L. Dissolved Gases: Surface waters shall be free of nitrogen and other dissolved gases at levels above 110% saturation when this supersaturation is attributable to municipal, industrial or other discharges.

M. Mixing Zones: In any waters receiving a waste discharge, a continuous zone must be maintained where the water is of adequate quality to allow the migration of all desirable aquatic life presently common in New Mexico waters with no significant effect on their populations. Wastewater mixing zones, in which the standards in Part 2 may be exceeded, shall generally be less than 1/4 of the cross-sectional area of a receiving stream or the volume below 1/100 of the surface area of a receiving reservoir.

N. Reservoirs: Unless specified, standards for reservoirs apply only to the epilimnion or, in the absence of an epilimnion, to the upper 1/3 of the reservoir.

Appendix B

NEW MEXICO REGULATIONS FOR DISCHARGE ONTO OR BELOW THE SURFACE OF THE GROUND, WQCC 81-2, JULY 2, 1981

3-100. REGULATIONS FOR DISCHARGES ONTO OR BELOW THE SURFACE OF THE GROUND.

3-101. PURPOSE.—

A. The purpose of these regulations controlling discharges onto or below the surface of the ground is to protect all ground water of the state of New Mexico which has an existing concentration of 10,000 mg/l or less TDS, for present and potential future use as domestic and agricultural water supply, and to protect those segments of surface waters which are gaining because of ground water inflow, for uses designated in the New Mexico Water Quality Standards. The regulations are written so that in general:

1. if the existing concentration of any water contaminant in ground water is in conformance with the standard of Section 3-103 of these regulations, degradation of the ground water up to the limit of the standard will be allowed; and

2. if the existing concentration of any water contaminant in ground water exceeds the standard of Section 3-103, no degradation of the ground water beyond the existing concentration will be allowed.

B. Ground water standards are numbers that represent the pH range and maximum concentrations of water contaminants in the ground water which still allow for the present and future use of ground water resources.

C. The standards are not intended as maximum ranges and concentrations for use, and nothing herein contained shall be construed as limiting the use of waters containing higher ranges and concentrations.

3-102. AUTHORITY.—Standards are adopted by the commission under the authority of Section 74-6-4, NMSA 1978 (the New Mexico Water Quality Act, Chapter 326, Laws of 1973, as amended). Regulations are adopted by the commission under the authority of Sections 74-6-4 and 74-6-5 NMSA 1978.

3-103. STANDARDS FOR GROUND WATER OF 10,000 mg/l TDS CONCENTRATION OR LESS.—The following standards are the allowable pH range and the maximum allowable concentration in ground water for the contaminants specified unless the existing condition exceeds the standard or unless otherwise provided in Subsection 3-109.D. or Section 3-110. When an existing pH or concentration of any water contaminant exceeds the standard specified in Subsection A, B, or C, the existing pH or concentration shall be the allowable limit, provided that the discharge at such concentrations will not result in concentrations at any place of withdrawal for present or reasonably forseeable future use in excess of the standards in this section.

These standards shall apply to the dissolved portion of the contaminants specified with a definition of dissolved being that given in the publication "Methods for Chemical Analysis of Water and Waste of the U.S. Environmental Protection Agency," with the exception of mercury which shall be total.

A. Human Health Standards—Ground water shall meet the standards of Section A and B unless otherwise provided.

Arsenic (As)	0.1 mg/l
Barium (Ba)	1.0 mg/l
Cadmium (Cd)	0.01 mg/l
Chromium (Cr)	0.05 mg/l
Cyanide (CN)	0.2 mg/l
Fluoride (F)	1.6 mg/l
Lead (Pb)	0.05 mg/l
Total Mercury (Hg)	0.002 mg/l
Nitrate (NO_3 as N)	10.0 mg/l
Selenium (Se)	0.05 mg/l
Silver (Ag)	0.05 mg/l
Uranium (U)	5.0 mg/l
Radioactivity: Combined Radium-226 and Radium-228	30.0 pCi/l

B. Other Standards for Domestic Water Supply

Chloride (Cl)	250. mg/l
Copper (Cu)	1.0 mg/l
Iron (Fe)	1.0 mg/l
Manganese (Mn)	0.2 mg/l
Phenols	0.005 mg/l
Sulfate (SO_4)	600. mg/l
Total Dissolved Solids (TDS)	1000. mg/l
Zinc (Zn)	10.0 mg/l
pH	between 6 and 9

C. Standards for Irrigation Use - Ground water shall meet the standards of subsections A, B, and C unless otherwise provided.

Aluminum (Al)	5.0 mg/l
Boron (B)	0.75 mg/l
Cobalt (Co)	0.05 mg/l
Molybdenum (Mo)	1.0 mg/l
Nickel (Ni)	0.2 mg/l

3-104. DISCHARGE PLAN REQUIRED.—Unless otherwise provided by these regulations, no person shall cause or allow effluent or leachate to discharge so that it may move directly or indirectly into ground water unless he is discharging pursuant to a discharge plan approved by the Director. When a plan has been approved, discharges must be consistent with the terms and conditions of the plan.

3-105. EXEMPTIONS FROM DISCHARGE PLAN REQUIREMENT.—Sections 3-104 and 3-106 of these regulations do not apply to the following:

A. Effluent or leachate which conforms to all the listed numerical standards of Section 3-103 and has a total nitrogen concentration of 10 mg/l or less, and does not contain any toxic pollutant. To determine conformance, samples may be taken by the agency before the effluent or leachate is discharged so that it may move directly or indirectly into ground water; provided that if the discharge is by seepage through non-natural or altered natural materials, the agency may take samples of the solution before or after seepage. If for any reason the agency does not have access to obtain the appropriate samples, this exemption shall not apply.

B. Effluent which is discharged from a sewerage system used only for disposal of household and other domestic waste which receives 2,000 gallons or less of liquid waste per day;

C. Water used for irrigated agriculture, for watering of lawns, trees, gardens or shrubs, or for irrigation for a period not to exceed five years for the revegetation of any disturbed land area, unless that water is received directly from any sewerage system;

D. Discharges resulting from the transport or storage of water diverted, provided that the water diverted has not had added to it after the point of diversion any effluent received from a sewerage system, that the source of the water diverted was not mine workings, and that the Director has not determined that a hazard to public health may result;

E. Effluent which is discharged to a watercourse which is naturally perennial; discharges to dry arroyos and ephemeral streams are not exempt from the discharge plan requirement, except as otherwise provided in this section;

F. Those constituents which are subject to effective and enforceable effluent limitations in a National Pollutant Discharge Elimination System (NPDES) permit, where discharge onto or below the surface of the ground so that water contaminants may move directly or indirectly into ground water occurs downstream from the outfall where NPDES effluent limitations are imposed, unless the Director determines that a hazard to public health may result. For purposes of this subsection, monitoring requirements alone do not constitute effluent limitations;

G. Discharges resulting from flood control systems;

H. Leachate which results from the direct natural infiltration of precipitation through disturbed materials, unless the Director determines that a hazard to public health may result;

I. Leachate which results entirely from the direct natural infiltration of precipitation through undistrubed materials;

J. Leachate from solids disposed of in accordance with the Solid Waste Management Regulations adopted by the New Mexico Environmental Improvement Board on April 19, 1974;

K. Natural ground water seeping or flowing into conventional mine workings which re-enters the ground by natural gravity flow prior to pumping or transporting out of the mine and without being used in any mining process; this exemption does not apply to solution mining;

L. Effluent or leachate discharges resulting from activities regulated by a mining plan approved and permit issued by the New Mexico Coal Surface Mining Commission, provided that this exemption shall not be construed as limiting the application of appropriate ground water protection requirements by the New Mexico Coal Surface Mining Commission;

M. Effluent or leachate discharges which are regulated by the Oil Conservation Commission and the regulation of which by the Water Quality Control Commission would interfere with the exclusive authority granted under Section 70-2-12 NMSA 1978, or under other laws, to the Oil Conservation Commission.

3-106. APPLICATION FOR DISCHARGE PLAN APPROVAL.—

A. Any person who, before or within 120 days after the effective date of these regulations, is discharging any of the water contaminants listed in Section 3-103 or any toxic pollutant so that they may move directly or indirectly into ground water shall, within 120 days of receipt of written notice from the Director that a discharge plan is required, or such longer time as the Director shall for good cause allow, submit a discharge plan to the Director for approval; such person may discharge without an approved discharge plan until 240 days after written notification by the Director that a discharge plan is required or such longer time as the Director shall for good cause allow.

B. Any person who intends to begin, more than 120 days after the effective date of these regulations, discharging any of the water contaminants listed in Section 3-103 or any toxic pollutant so that they may move directly or indirectly into ground water shall notify the Director giving the information enumerated in Subsection 1-201.B.; the Director shall, within 60 days, notify such person if a discharge plan is required; upon submission, the Director shall review the discharge plan pursuant to Sections 3-108 and 3-109; for good cause shown, the Director may allow such person to discharge without an approved plan for a period not to extend beyond one year after the effective date of these regulations; after one year after the effective date of these regulations, for good cause shown the Director may allow such person to discharge without an approved discharge plan for a period not to exceed 120 days.

C. A proposed discharge plan shall set forth in detail the methods or techniques the discharger proposes to use or processes expected to naturally occur which will ensure compliance with these regulations. At least the following information shall be included in the plan:

1. Quantity, quality and flow characteristics of the discharge;

2. Location of the discharge and of any bodies of water, watercourses and ground water discharge sites within one mile of the outside perimeter of the discharge site, and existing or proposed wells to be used for monitoring;

3. Depth to and TDS concentration of the ground water most likely to be affected by the discharge;

4. Flooding potential of the site;

5. Location and design of site(s) and method(s) to be available for sampling, and for measurement or calculation of flow;

6. Depth to and lithological description of rock at base of alluvium below the discharge site if such information is available; and

7. Any additional information that may be necessary to demonstrate that approval of the discharge plan will not result in concentrations in excess of the standards of Section 3-103 or the presence of any toxic pollutant at any place of withdrawal of water for present or reasonably foreseeable future use. Detailed information on site geologic and hydrologic conditions may be required for a technical evaluation of the applicant's proposed discharge plan.

3-107. MONITORING, REPORTING, AND OTHER REQUIREMENTS.—

A. Each discharge plan shall provide for the following as the Director may require:

1. The installation, use, and maintenance of effluent monitoring devices;

2. The installation, use, and maintenance of monitoring devices for the ground water most likely to be affected by the discharge;

3. Monitoring in the vadose zone;

4. Continuation of monitoring after cessation of operations;

5. Periodic submission to the director of results obtained pursuant to any monitoring requirements in the discharge plan and the methods used to obtain these results;

6. Periodic reporting to the director of any other information that may be required as set forth in the discharge plan;

7. The discharger to retain for a period of at least five years any monitoring data required in the discharge plan;

8. A system of monitoring and reporting to verify that the plan is achieving the expected results;

9. Procedures for detecting failure of the discharge system;

10. Contingency plans to cope with failure of the discharge plan or system;

11. Measures to prevent ground water contamination after the cessation of operation, including post-operational monitoring.

B. Sampling and analytical techniques shall conform with the following references unless otherwise specified by the director:

1. Standard Methods for the Examination of Water and Wastewater, latest edition, American Public Health Association; or

2. Methods for Chemical Analysis of Water and Waste and other publications of the Analytical Quality Laboratory, EPA; or

3. Techniques of Water Resource Investigations of the U.S. Geological Survey.

C. The discharger shall notify the director of any facility expansion, production increase or process modifications that would result in any significant modification in the discharge of water contaminants.

D. Any discharger of effluent or leachate shall allow any authorized representative of the director to:

1. inspect and copy records required by a discharge plan;

2. inspect any treatment works, monitoring and analytical equipment;

3. sample any effluent before or after discharge;

4. use monitoring systems and wells installed pursuant to a discharge plan requirement in order to collect samples from ground water or the vadose zone.

3-108. PUBLIC NOTICE AND PARTICIPATION.--

A. Within thirty (30) days of filing of a proposed discharge plan, the director shall notify the following persons:

1. the public, who shall be notified through publication of a notice in a newspaper of general circulation in this state;

2. those persons who have requested notification, who shall be notified by mail;

3. any local, state or federal governmental agency affected which shall be notified by certified mail.

B. The public notice shall include:

1. name and address of the proposed discharger;

2. location of the discharge;

3. brief description of the activities which produce the discharge described in the proposed discharge plan;

4. quantity, quality and flow characteristics of the discharge;

5. depth to and TDS concentration of the ground water most likely to be affected by the discharge;

6. brief description of the procedures followed by the director in making a final determination;

7. statement on the comment period; and

8. address and telephone number at which interested persons may obtain further information.

C. Following the public notice and prior to ruling on any proposed discharge plan or its modificiation, the director shall allow a period of at least thirty (30) days during which comments may be submitted to the director and a public hearing may be requested by any interested person. Requests for a public hearing shall set forth the reasons why a hearing should be held. A public hearing shall be held if the director determines there is significant public interest. The time and place of the hearing shall be determined by the director and notice shall be given at least thirty (30) days prior to the hearing pursuant to Subsections A and B above. The director may appoint a hearing officer. A transcript of the hearing shall be made at the request of either the director or the discharger and at the expense of the person requesting the transcript. At the hearing, all interested

persons shall be given a reasonable chance to submit data, views or arguments orally or in writing and to examine witnesses testifying at the hearing.

3-109. DIRECTOR APPROVAL, DISAPPROVAL, MODIFICATION OR TERMINATION OF PROPOSED DISCHARGE PLANS.—

A. If no public hearing is held pursuant to Subsection 3-108.C., then the director shall, within sixty (60) days after all required information is available to him, approve or disapprove the proposed plan based on the information available to him.

B. If a public hearing is held pursuant to Subsection 3-108.C., then the director shall, within sixty (60) days after the public hearing or after all required information is available to him, whichever is later, approve or disapprove the proposed plan based on information contained in the proposed plan and information submitted at the hearing.

C. Provided that the other requirements of these regulations are met and provided further that the discharge plan demonstrates that neither a hazard to public health nor undue risk to property will result, the director shall approve a proposed discharge plan if the following requirements are met:

1. ground water that has a TDS concentration of 10,000 mg/l or less will not be affected by the discharge, or

2. the person proposing to discharge demonstrates that approval of the discharge plan will not result in either concentrations in excess of the standards of Section 3-103 or the presence of any toxic pollutant at any place of withdrawal of water for present or reasonably foreseeable future use, except for contaminants in the water diverted as provided in Subsection 3-109.D., or

3. the plan conforms to either Subsection a or b below and Subsection c below.

a. Municipal, Other Domestic Discharges, and Discharges from Sewerage Systems Handling Only Animal Wastes.

The effluent is entirely domestic, is entirely from a sewerage system handling only animal wastes or is from a municipality and conforms to the following:

(1) the discharge is from an impoundment or a leach field existing on the effective date of these regulations which receives less than 10,000 gallons per day and the director has not found that the discharge may cause a hazard to public health; or

(2) the discharger has demonstrated that the total nitrogen in effluent that enters the subsurface from a leach field or surface impoundment will not exceed 200 pounds per acre per year and that the effluent will meet the standards of Section 3-103 except for nitrates and except for contaminants in the water diverted as provided in Subsection 3-109.D.; or

(3) the total nitrogen in effluent that is applied to a crop which is harvested shall not exceed by more than 25% the maximum amount of nitrogen reasonably expected to be taken up by the crop and the effluent shall meet the standards of Section 3-103 except for nitrates and except for contaminants in the water diverted as provided in Subsection 3-109.D.

b. Discharges from industrial, mining or manufacturing operations.

(1) the discharger has demonstrated that the amount of effluent that enters the subsurface from a surface impoundment will not exceed 0.5 acre-feet per acre per year; or

(2) the discharger has demonstrated that the total nitrogen in effluent that enters the subsurface from a leach field or surface impoundment shall not exceed 200 pounds per acre per year and the effluent shall meet the standards of Subsection 3-103 except for nitrate and contaminants in the water diverted as provided in Subsection 3-109D.; or

(3) the total nitrogen in effluent that is applied to a crop that is harvested shall not exceed by more than 25% the maximum amount of nitrogen reasonably expected to be taken up by the crop and the effluent shall meet the standards of Section 3-103 except for nitrate and contaminants in the water diverted as provided in Subsection 3-109D.

c. All Discharges.

(1) the monitoring system proposed in the plan includes adequate provision for sampling of effluent and adequate flow monitoring so that the amount being discharged onto or below the surface of the ground can be determined.

(2) the monitoring data is reported to the director at a frequency determined by the director.

D. The director shall allow the following unless he determines that a hazard to public health may result:

1. the weight of water contaminants in water diverted from any source may be discharged provided that the discharge is to the aquifer from which the water was diverted or to an aquifer containing a greater concentration of the contaminants than contained in the water diverted; and provided further that contaminants added as a result of the means of diversion shall not be considered to be part of the weight of water contaminants in the water diverted;

2. the water contaminants leached from undisturbed natural materials may be discharged provided that:

a. the contaminants were not leached as a product or incidentally pursuant to a solution mining operation; and

b. the contaminants were not leached as a result of direct discharge into the vadose zone from municipal or industrial facilities used for the storage, disposal, or treatment of effluent;

3. the water contaminants leached from undisturbed natural materials as a result of discharge into ground water from lakes used as a source of cooling water.

E. If data submitted pursuant to any monitoring requirements specified in the approved plan or other information available to the director indicates that these regulations are being or may be violated or that the standards of 3-103 are being or will be exceeded in ground water at any place of withdrawal for present or reasonably foreseeable future use due to the discharge, except as provided in Subsections 3-109D. and Section 3-110 of these regulations;

1. the director may require a discharger to modify a discharge plan within the shortest reasonable time so as to achieve compliance with these regulations and to provide that any exceeding of standards in ground water at any place of withdrawal for present or reasonably foreseeable future use due to the discharge except as provided in Subsections 3-109D. and Section 3-110 will be abated or prevented.

2. the director may terminate an approved discharge plan when a discharger fails to modify the plan in accordance with Subsection E.1. of this subsection.

F. At the request of the discharger, an approved discharge plan may be modified in accordance with these regulations.

G. The director shall not approve a discharge plan for:

1. any discharge for which the discharger has not provided a site and method for flow measurement and sampling;

2. any discharge that will cause any stream standard to be violated;

3. the discharge of any water contaminant which may result in a hazard to public health; or

4. a period longer than five years.

3-110. APPROVAL OR DISAPPROVAL OF PROPOSED DISCHARGE PLANS THAT DO NOT MEET THE STANDARDS OF SECTION 3-103.

A. The discharger may file a written petition with the director seeking commission consideration of a discharge plan that would not meet the standards of Section 3-103 if he believes that the discharge plan demonstrates the maximum use of technology within the economic capability of the discharger or that there is no reasonable relationship between the economic and social costs and benefits (including attainment of the standards of Section 3-103) to be obtained and that discharge under the plan would not create a hazard to public health or undue risk to property.

B. The petition shall state the extent to which the plan would violate the standards of Section 3-103 and why the plan should be approved. The director may transmit the petition to the commission recommending that it be approved or refuse to transmit the petition.

C. If the director transmits the petition to the commission, the commission shall review the petition and determine to either grant or deny a public hearing on the applicability of the criteria of Subsection A above to the proposed discharge plan.

D. If the director refuses to transmit the proposed discharge plan to the commission, or if the commission refuses to grant a hearing on the applicability of the criteria of Subsection A above to

the proposed discharge plan, the director shall act on the proposed discharge plan without consideration of the criteria of Subsection A.

E. If the director denies the proposed discharge plan purusant to Subsection D, then the discharger may address the issue of whether the proposed discharge plan meets the criteria of Subsection A above upon appeal of the director's disapproval of his proposed discharge plan to the commission in accordance with the provisions of Subsection 74-6-5(L) NMSA 1978.

F. If the commission grants a public hearing, the hearing shall be held in accordance with the provisions of Subsection 74-6-5(L), (M) and (N), NMSA 1978 Comp.

G. If the commission, after hearing held pursuant to Subsection F, denies the proposed discharge plan, the discharger may appeal pursuant to Section 74-6-5(O) NMSA 1978 and on appeal may address the issue of whether the proposed discharge plan meets the criteria of Subsection A.

H. After public hearing and consideration of all facts and circumstances included in Section 74-6-4(D) NMSA 1978 the commission may authorize the director to approve a proposed discharge plan if the commission determines that the plan meets the criteria of Subsection A above.

3-111. TRANSFER OF DISCHARGE PLAN.--

A discharger shall notify by letter the succeeding owner of a facility which is operating pursuant to an approved discharge plan of the existence of the discharge plan. The notice shall be given on or before transfer of possession of the facility. A copy of the letter shall be forwarded to the director. The succeeding owner shall be responsible for compliance with the approved discharge plan upon taking possession of the facility and receiving notice of the discharge plan.

3-112. APPEALS FROM DIRECTOR'S DECISIONS.--

A. If the director disapproves a proposed discharge plan, approves a proposed discharge plan subject to condition, or modifies or terminates an approved plan, appeal therefrom and any action of the commission thereon shall be in accordance with the provisions of Subsections 74-6-5(L), (M) and (N), NMSA, 1978.

B. If the director determines that a discharger is not exempt from filing a discharge plan pursuant to Section 3-105, or that the material to be discharged contains any toxic pollutant as defined in Section 1-101.X., which is not included in the numerical standards of 3-103, the discharger may appeal such determination by filing a notice of appeal to the commission within thirty days after receiving the director's written determination, and the appeal therefrom and any action of he commission thereon shall be in accordance with the provisions of Subsections 74-6-5 (L), (M) and (N), NMSA 1978.

3-113. APPEALS FROM COMMISSION DECISIONS--A discharger may appeal the decision of the commission in accordance with the provisions of Section 74-6-5(O) NMSA 1978.

3-114. SEVERABILITY.—If any section, subsection, individual standard or application of these standards or regulations is held invalid, the remainder shall not be affected.

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